

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

• EDITOR

Howard P. Doub, M.D.
Detroit, Michigan



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Clinical and Radiological Studies of Pulmonary Mycosis¹

WAYNE A. JOHNSTON, M.D., and JULIUS HEYDEMANN, M.D.

Dubuque, Iowa

SINCE THE FIRST observation of a yeast fungus by Hooke in 1677, many fungi have been described, but only a small number have been found to be pathogenic to animals and man. The identification and classification of the fungus by cultural and growth characteristics are difficult and often involve a tremendous amount of work.

The purpose of this paper is to review and summarize the literature as it pertains to yeasts in their relation to the ills of man, especially of the lungs, and to present several cases of mycotic infection encountered in a relatively short period of eight months. Our review of the literature has been quite extensive and has impressed us with the general distribution of yeast, the insidious manner in which it starts its career in the human host, the diversified manifestations it produces, and the apparent difficulties encountered in making a positive diagnosis. From a practical standpoint, there seems to be sufficient similarity in the lesions produced that the history, tissue findings, roentgen findings, and sequelae of all yeast infections should be discussed as though these were a single entity, and any variation, one only of degree of virulence but not necessarily characteristic for the species. This will simplify the general pic-

ture and perhaps encourage clinicians to be more diligent in looking for these infections.

In taking the above point of view, we do not wish to depreciate the fine work which has been done in grouping, subgrouping, and identifying end-strains of these organisms. It may be that at a future time distinctive characteristics for particular types of yeast infections will be worked out by their more frequent diagnosis.

DISTRIBUTION

Yeast infections of all types have been reported from various parts of North America, South America, and Europe. Practically no region can be said to be exempt, though certain infections seem to have a high regional incidence, as coccidioidomycosis, which appears to be endemic in the San Joaquin Valley district of California. The frequency of types under observation may also vary according to the location of the observer.

Susceptibility does not seem to vary with race, color, or age so much as with change in location from a non-infected to an infected area. The infection is not considered to be transmitted from one person to another. For coccidioidomycosis it has been reported that in the early or infectious stages women outnumber men, 2:1, while in the late or granulomatous stages males are more often involved, 4:1.

We took particular notice in studying

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

case reports to observe whether any particular occupation produced more infections than another, but there does not seem to be any occupational prevalence. One of us, however, encounters a large number of cases of blastomycosis of the skin each year, all in farmers raising cattle and in men in packing houses or stockyards handling cattle. Each farmer so infected will tell us that his cattle have sores. Reports from the veterinary departments of two leading universities state that they know very little about the frequency of mycotic skin infections in cattle. In spite of this possible contact, the incidence of pulmonary mycosis among farmers is not higher than among those in any other occupation. By contrast, a newcomer into the San Joaquin Valley very often contracts coccidioidomycosis from the dust, although the natives have little trouble. It is quite certain that the natives of this valley have an immunity; perhaps the same is true for the farmer. We hope to learn more about the skin sores of cattle. At the present time, however, we know little concerning the exact source of yeast infections other than those from the dust of the San Joaquin Valley.

PATHOLOGY

The spores of yeast may persist for many years. They withstand a lot of heat, cold, and drying. We do not know the requirements for a yeast infection; ordinarily the spores grow in a slightly acid medium, whereas the body juices are slightly alkaline under normal conditions. It has been suggested that perhaps some other disease, as influenza, pneumonia, tuberculosis, bronchiectasis, a neoplasm, etc., may produce temporary pH changes sufficient for the organisms to start their growth.

The primary infection most often occurs through the respiratory tract. The organism grows and multiplies in the secretions. Sufficient ulceration of the mucosa must result to permit the yeast to gain a foothold in the lung tissues bordering the bronchi. Yeasts themselves do not seem

to attract much defense mechanism by the body, either in the form of cellular infiltration or fibrosis. The extension of the infection, with coalescence into nodules and breaking down into abscesses, may occur from the yeast alone or in conjunction with some associated infection; or areas of bronchopneumonia may develop as a result of an associated disease taking advantage of the damage done by the yeast.

At some stage in the spread of the more virulent infections, either through ulcerations or caseations, or both, a large number of organisms must gain entrance into the blood or lymph stream. These are deposited all over the body, especially in the brain, meninges, liver, spleen, lungs, kidneys, and bones. These lesions appear to grow rapidly and to develop a high degree of "toxicity," since such generalized cases have a very high mortality rate. This is especially true of coccidioidal granuloma and torula infections, but also occurs in moniliasis, blastomycosis, and other mycotic infections.

Probably the majority of yeast infections never get beyond the bronchi; a few reach the peribronchial tissues, the lung parenchyma, and the lymph nodes, and involve the pleura; even fewer are disseminated through the body.

Microscopically the pure lesion of a mycotic infection is a tubercle-like granuloma. The central area is caseous and even in young lesions does not contain epithelioid cells, though it may contain giant cells. The borders of these granulomas may show very little fibrosis and only relatively few round cells. The walls of abscess cavities are virtually the same. Many yeast spherules are found in the contents of the abscesses. Mycoses complicated by other pyogenic infections or a tuberculous infection will also show the microscopic cell structure of these infections.

HISTORY

The clinical symptoms of pulmonary mycosis vary in degree and type, depending upon the virulence of the infection,

extent of development, and rapidity of extension. In mild cases the symptoms are those associated with any pulmonary infection. In some instances symptoms may have persisted for years, in the form of a mild cough, occasional chest pain, loss of energy, etc. A chronic dry cough, often unproductive, is the most common symptom of all; other than this there is no characteristic manifestation.

In severe cases there may be such symptoms as malaise, low-grade fever, occasional hemoptysis, chills, night sweats, and other evidence of pulmonary disease. The sputum often has a foul, nauseating odor; this is about the only sign which may suggest the presence of a fungus infection.

In the disseminating stage the symptoms are all referable to the organ affected. In case of brain or meningeal involvement there may be a history of severe headache as the predominant symptom; other signs referable to the central nervous system may develop, but all of them are the same as in other diseases involving the particular organ. Lesions in the liver, spleen, kidneys, etc., produce few, if any, symptoms.

Physical examination of the lungs often fails to reveal many abnormal findings; occasional râles, alteration of breath sounds, and patchy areas of dullness may be found, but these findings are present, also, in tuberculosis, sarcoidosis, pneumoconiosis, bronchiectasis, metastatic neoplasms, etc. In some cases physical findings may be marked, but often they do not indicate any severe changes. Frequently the clinician is surprised to see the extensive changes demonstrated by the x-ray film.

While the clinician is the first to recognize the presence of some sort of pulmonary disease, the roentgenologist is the first to learn its extent and distribution and often he can suggest its nature. The pathologist or bacteriologist must make the final diagnosis, since the only un-failing evidence of the disease is the actual demonstration of the fungus itself

in the sputum culture or in the culture of secretion directly obtained from the bronchial tree. It is not only necessary for the detection of the disease that it be kept in mind in the differential diagnosis of pulmonary conditions, but also that there be teamwork between the clinician, radiologist, bacteriologist, and often the bronchoscopist.

ROENTGEN FINDINGS

Yeast infections may produce certain pulmonary reactions, depending on the stage, duration, and to a lesser degree the type of the infection. Probably the earliest lesions to be recognized show only slightly increased markings of the bronchovascular structure. There may be some irregular peribronchial infiltration. This may be unilateral and is more often on the right side; later a similar lesion may develop on the left side. Some authors describe enlarged lymph nodes in the hilar zones and upper mediastinum. This finding was not present in our cases, either early or late. Patchy areas of density appear in the parenchyma, mostly along the bronchi. These may be of miliary size or in the form of large nodules. They may increase, coalesce, and break down into abscesses. The lesions may gradually extend toward the periphery and, when they reach the pleura, may produce pleural thickening, which is often localized adjacent to the area of parenchymal infiltration. Pleural effusion is fairly rare. Another type of involvement may show faint fuzzy shadows along the bronchovascular structure, giving it a ground-glass appearance. These shadows extend to the periphery. Later a moderate fibrosis may develop or the lesions may disappear, even without treatment. It is unusual for lesions of this type to break down and form abscesses.

Advanced cases may present still another type of lesion in the lung, which seems to be definitely associated with a general dissemination of the infection throughout the body. One sees discrete nodules in the pulmonary parenchyma, ap-

parently not associated with the bronchi. These are quite dense and not sharply demarcated. The lesions vary in size; some are isolated, while others are more or less grouped in irregular masses. Some of these lesions break down to form abscesses. Draining sinuses may develop, especially in cases of actinomycosis.

During the stage of convalescence, gradual absorption of the parenchymal lesions takes place, abscesses disappear, and finally the increased markings of the bronchovascular structure become less prominent. Under treatment these lesions occasionally seem to melt away like snow. Extensive changes take place in a few weeks, as contrasted to the slow improvement in tuberculosis. As in pneumonia, or more often in tuberculosis, some cases do not clear up entirely but leave chronic cavities and areas of fibrosis.

Tuberculosis may and frequently does develop in a mycotic lung. In most cases it would be difficult to determine which disease occurred first. Regardless of which has priority, the roentgen appearance becomes more confusing and its correct interpretation more difficult. There is a tendency to attach little significance to the presence of yeast, once a tubercle bacillus is demonstrated. This we believe may be a definite mistake. In one of our cases we feel we have ample evidence to prove that yeast is playing a most active part in the lung and that, while tuberculosis is present in an active form, we cannot expect much improvement in the latter until the former is in great part eradicated.

The roentgenographic differentiation of yeast infection from tuberculosis is not at all reliable. Lymph node enlargement, we believe, is more common in tuberculosis. The presence of enlarged nodes in the hila or along the mediastinum, therefore, is more suggestive of tuberculosis than of mycosis or pneumonia. Cavities are considered to be more numerous in tuberculosis, especially in the apical regions. The older lesions of tuberculosis are usually associated with more fibrosis.

Pulmonary sarcoidosis may show en-

largement of the hilar nodes, with infiltrations radiating outward into the periphery, and miliary and nodular infiltrations of the lungs. The distribution of the pulmonary lesions may be more symmetrical than in yeast infections. Proved cases of sarcoidosis have shown a great variation in the lesions as they appear in the roentgenogram. Skin lesions or mucous membrane lesions are nearly always present in sarcoidosis, from which biopsies may be taken for differential diagnosis. In both diseases there may be cystic lesions in the bones of the hands or feet. Those caused by mycosis usually are more painful and often have draining sinuses.

Cancer metastases are in most cases larger and progress more rapidly than mycotic lesions. Miliary or nodular densities are fewer in number in cancer patients, and larger areas of inflammatory reaction and of atelectasis are apt to be present. Metastatic lesions show a tendency to be more confined to the lower lobes. The primary lesions are almost always recognizable clinically.

The lesions of active bronchopneumonia are more flame-like, disseminating outward from the bronchovascular structure. There is marked variation in the size of the shadows compared to the more uniform shadows of mycotic infection. The individual densities are less homogeneous in bronchopneumonia and tend to change rather rapidly in size. In cases of delayed resolution of pneumonia and of chronic fibroid pneumonia, one will encounter more fibrosis and often abscesses with thicker walls. Pneumonia rarely involves both lungs in the same degree, either in the acute or chronic stage. The more rapid course of the disease may also be helpful in the differentiation. Cases of so-called atypical and virus pneumonia should also be excluded.

The nodular stage of pneumoconiosis may be extremely confusing. In this disease the nodules are discrete and usually quite uniform in distribution, most often involving both lungs. In the later stages there may be, and often is, a conglomerate

tion of nodules but rarely abscess formation, whereas in mycotic infections such conglomerations tend to develop into abscesses. In pneumoconiosis the parietal pleura is often quite dense and rather uniformly so, whereas the pleura of pulmonary mycosis is thickened chiefly where the lesions reach the periphery of the lung. Emphysema in the uninvolved portions of the lungs may be greater in pneumoconiosis. Fluoroscopically a considerable limitation in the excursion of the diaphragm is demonstrable; this is not usually present in pulmonary mycosis.

TREATMENT

The most universal and most successful treatment of pulmonary mycosis seems to be by iodides and x-ray. Saturated potassium iodide should be given in doses of 30 grains a day in three divided doses. This should be increased 3 grains a day until a total dose of 120-250 grains a day is given. The total dose depends on the weight of the patient and his tolerance. If treatment is carried out as above, not over 4 in 100 will have any difficulty. Severe breaking out of skin nodules or gastric distress may force a lower total dose or sometimes prevent use of the drug altogether. In addition to the dosage by mouth, once it is determined the patient is not allergic to the iodides, sodium iodide should be given intravenously, daily for two to three weeks. Following this, the oral dosage should be ample if given over a sufficient period of time. We have found no proved contraindication to the iodides in the presence of tuberculosis. X-ray radiation is given once or twice a week over the chest and skin lesions, using as a rule not over 100 r per area treated.

Some authors maintain that, in treating moniliasis and blastomycosis, the patient must be desensitized to the yeasts before receiving iodides. This is done by giving Lucas vaccine, 0.1 c.c. twice daily and increasing to 0.8 c.c., for a total of eighteen injections. Immune rabbit serum is also used for desensitizing. Whether or not desensitization should be carried out



Fig. 1. Case 1: Irregular shadows extending outward from both hilar zones and other evidences of mycotic infection.

previous to the giving of iodides in the treatment of other yeast infections, we do not know, nor do we find any such information in the literature. Ethyl iodides are sometimes substituted as an inhalant. The dose is started at 0.5 c.c. and increased gradually to 3.0 c.c. three times a day. Some authors claim to have used successfully 40 per cent iodized oil intrabronchially at weekly intervals.

CASE REPORTS

CASE 1:² B. B., white housewife, age 66. In October 1919, the patient began to cough and to notice blood-tinged sputum. She lost weight, became very weak, and had to remain in bed for several months but eventually recovered. She experienced a similar episode in the summer of 1927. She was then well until April 1942, when she again began to cough. On admission to the hospital, in December 1942, she complained of coughing spells, shortness of breath, and occasional blood-tinged sputum. She had lost 12 pounds in weight.

The patient's temperature was 97.5° to 99.6°. She was short of breath and expansion of the chest was limited on both sides, with dullness in the left lower lung field posteriorly and inconstant râles on the right and left sides.

Blood studies showed hemoglobin 88 per cent; white cells 9,600, with a normal differential count; red blood cells 4,620,000; Wassermann negative.

² Reported through the courtesy of K. Hazlet, M.D., Dubuque, Iowa.

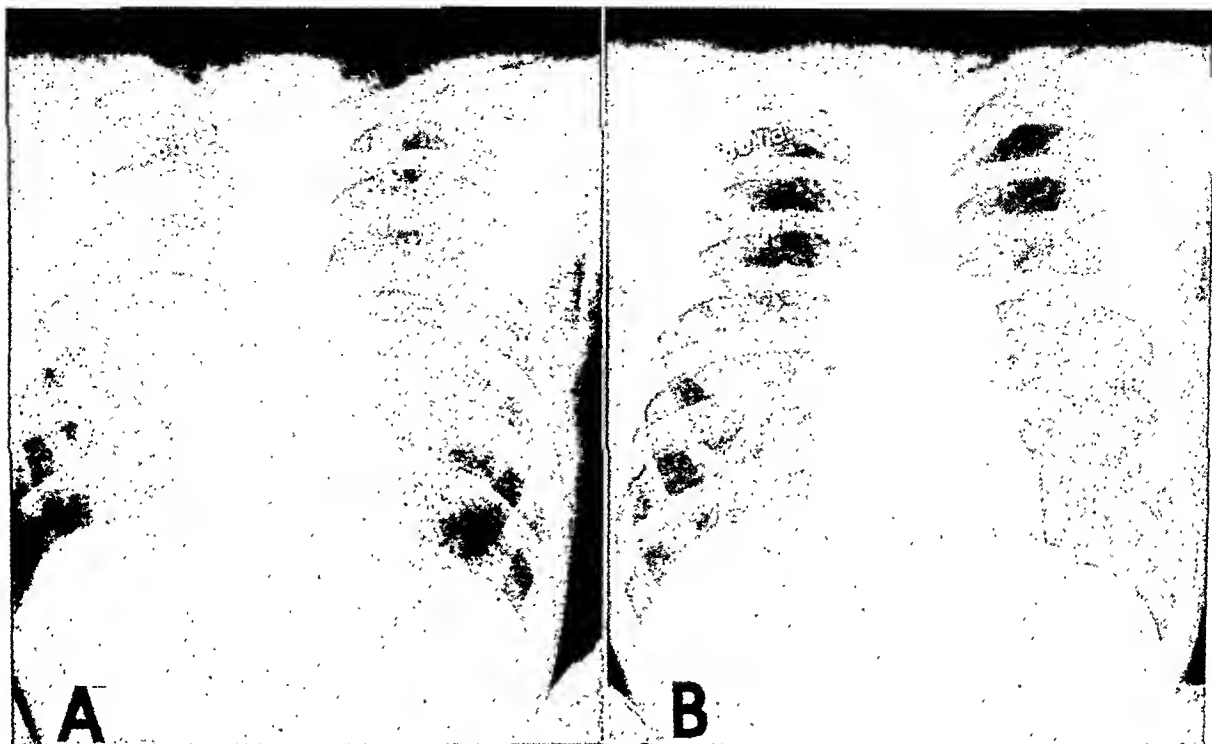


Fig. 2. Case 2: A. Admission roentgenogram showing miliary shadows, especially in the hilar zones. B. Disappearance of lesions following potassium iodide therapy.

Examination of the sputum revealed no predominating bacteria. Culture of the sputum on Feb. 11, 1943, showed numerous colonies of yeast in twenty-four hours. No tubercle bacilli were found in any of several examinations.

Roentgen films of the chest (Fig. 1) showed irregular mesh-like densities extending outward from both hilar zones, decreasing peripherally, more prominent on the right than on the left, and limited mostly to the lower lobes; consolidation in the left lower lobe; increased bronchial markings throughout the upper lobes, with some emphysema; very little if any beading in either lung field. The heart was not unusual.

Clinical Impression: Mycotic lung infection.

Sequelae: The patient left the hospital on April 20, 1943, and died a few weeks later. Autopsy could not be obtained.

CASE 2: J. S., white farmer, age 50. The patient had an acute cold four months prior to admission, severe enough to keep him in bed for four days. Following this he had a persistent cough and dyspnea, though he felt well when in bed. He was referred for study because of increasing weakness and loss of 20 pounds in weight. He was receiving creosote medication.

Physical examination revealed tachycardia (120). There were a few moist râles in the lower lung fields. The temperature was 103° on admission, but returned to normal a few days later.

Blood examination while the patient was in the

hospital showed a normal red and white cell count and hemoglobin, but when he was first seen at home the white count was 26,000, with 77 per cent polymorphonuclears. Repeated sputum examinations were negative for tubercle bacilli. Concentrated sputum also failed to show tubercle bacilli. The culture showed no yeast.

Roentgen films (Fig. 2A) of the chest showed prominent hilar zones on each side. Increased bronchovascular markings were present. There was also a mesh-like distribution of miliary soft densities most marked around the hilar zones and decreasing peripherally. The apices were clear.

Sequelae: The patient rapidly improved under potassium iodide medication and left the hospital, after one month, in excellent condition. A roentgen film six months later, Sept. 7, 1943, showed almost a normal lung (Fig. 2B).

Clinical Impression: In view of the absence of tubercle bacilli from the sputum and the patient's rapid improvement under potassium iodide medication, it is our opinion that the pulmonary condition was a mycotic infection.

CASE 3: L. H., white farmer, age 34. The patient had quit farming one year ago because of weakness and vertigo. He had been unable to work for three months because of painful swelling of his feet and legs. Recent complaints were general weakness for three weeks, dyspnea on exertion, diarrhea, increasing insomnia and nervousness. There was a chronic non-productive cough.

The patient's temperature ranged from 99° to 102°; the pulse was 100 to 120. There was slight dullness in the right upper lobe posteriorly. There were no riles. The spleen was palpable. The feet were swollen and edematous. The skin was moist and the patient perspired continuously.

The blood examination showed hemoglobin 12 gm.; white count 9,800, with normal differential; red count 4,000,000. The sputum was negative for tubercle bacilli on repeated examinations. Culture of the sputum showed many yeast colonies after several days' incubation. The Kahn test was negative.

A roentgen film of the chest (Fig. 3) showed a large number of irregular feathery nodules scattered throughout both lung fields, but especially in the upper portions. The extreme apices were less involved. There was a tendency to confluence of nodules in the areas lateral to both hilar zones. Multiple cavities were present in the right upper lobe, with pleural thickening in the surrounding region. No definitely demarcated wall surrounded the cavities. Markings in the hilar zones were conspicuously absent. The heart shadow appeared very hypoplastic. An upright film demonstrated a fluid level in one abscess cavity. A film taken two weeks later, one day before death, showed a great increase in the size and number of nodules throughout the left base, with much confluence; the lesser involved area of both lungs showed severe emphysema.

Sequelae: The patient's condition grew rapidly worse. Bilateral foot drop developed after eight days. Speech was difficult the last few days. Death occurred on the seventeenth day after admission.

*Postmortem Report:*³ "The right lung is adherent to the chest wall and mediastinal tissues, especially in the upper half. The lung feels hard and nodular. On section it is studded with opaque or semi-opaque yellow areas which are confluent in the upper half. They resemble tubercles but seem less cascated than might be expected considering the degree of involvement in the lung. Toward the apex there are large and small cavities. The left lung is heavy and dark red. The pleura shows a little acute fibrinous exudate over the surface. On section most of the cut surface is dark red, but scattered through it are opaque yellow areas which at first glance resemble abscesses or infected infarcts. On further study they show no evidence of softening and little inflammatory reaction at their peripheries. They vary in size between 0.25 and 1.5 cm. in width and, while largely at the periphery of the lung, also appear scattered through the cut surface. As far as can be made out, the hilar lymph nodes are not involved. Aside from a small and recent infarct on the left, the kidneys are not remarkable. The ureters, urinary bladder, and genitalia are negative. Other organs and tissues are not unusual.

³ Performed by F. P. McNamara, M.D., Dubuque, Iowa.



Fig. 3. Case 3: Feathery nodules scattered through both lung fields.

Microscopic Findings: Several sections of each lung show the same picture (Fig. 4), differing only in extent. They show the lesions noted grossly to be irregularly rounded areas of acute hyalinized necrosis. In some the phantom of the lung structure can be made out while in others pyknotic nuclei and nuclear dust indicate more degeneration. Rarely in the sections chosen is there a tendency for the centers of the lesions to break down and form cavities. Occasionally in such areas rounded bodies can be made out, resembling the yeast cells found in the cultures. A striking feature is the scant cellular reaction about the lesions. Usually there are a few round cells, apparently lymphocytes, and more rarely typical giant cells appear. Because of the similarity of the lesions to tubercles, the sections were stained for tubercle bacilli but none were found.

"Similar although smaller lesions were found in the spleen and kidney; the lesion thought to be an infarct also shows the same picture as seen in the lungs. The liver cells are largely replaced by fat globules and there is a slight increase of round cells about the hepatic trinity."

Postmortem Diagnosis: Chronic mycotic infection of the lungs, spleen, and left kidney. Fungus classified as *Monilia krusei* by N. F. Conant, M.D., Department of Mycology, Duke University.

CASE 4:⁴ M. D., white housewife, age 28. This patient had an abdominal hysterectomy in May 1942. She had no cough or chest symptoms at that time. Her convalescence was normal. In June 1943 she was sent to the hospital because of cough,

⁴ Reported through the courtesy of Luke Faber, M.D., Dubuque, Iowa.

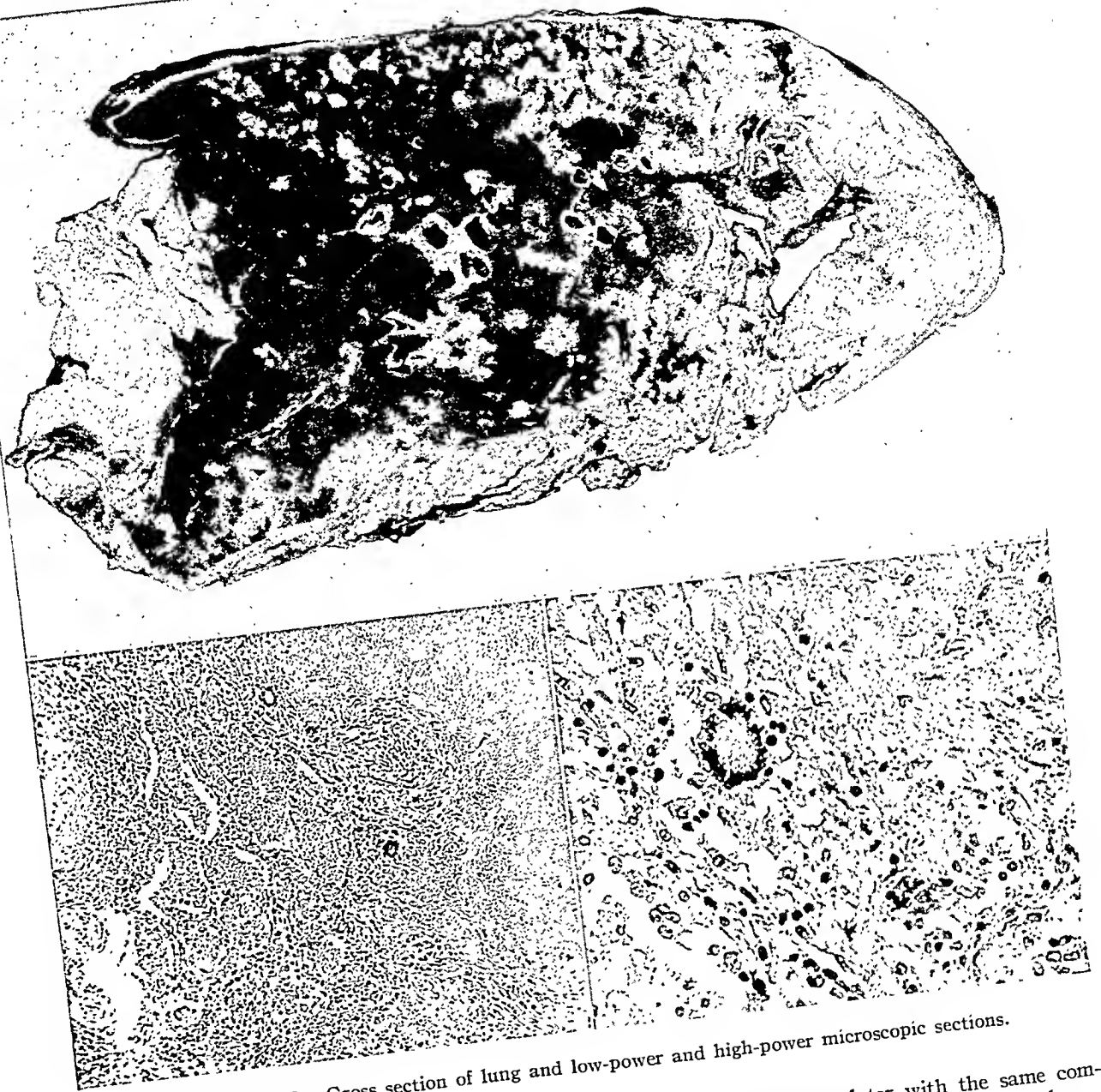


Fig. 4. Case 3: Gross section of lung and low-power and high-power microscopic sections.

weakness, tachycardia, palpitation, profuse sweating, and pain in the lower part of the abdomen. She had had frequent chills during the last four or five months. During her stay in the hospital her temperature varied from 103° to normal. Physical examination showed normal breath sounds, no dullness, no vocal fremitus, and no friction rubs. Heart sounds were normal but a tachycardia was observed. No chest films were ordered during this period in the hospital. A tuberculin skin test was negative. There was no sputum, and only a slight cough was reported one night. The patient left the hospital with a normal temperature and feeling much better at the end of four weeks. She was re-

admitted three months later with the same complaints and her general condition was very bad.

Physical examination revealed crepitant râles in both lungs with diminished breath sounds and slightly impaired resonance. The right apex was hyperresonant. The patient was coughing a great deal but raised very little sputum.

The blood showed 9 gm. hemoglobin; red cell count 3,000,000; white cell count 20,000 (85 per cent polymorphonuclears). No malaria was found. The sputum showed tubercle bacilli, staphylococci, streptococci, and yeast cells. Very many yeast colonies were obtained by culture.

Bedside X-Ray Examination (Fig. 5): "Through-

out the entire left lung and the lower two-thirds of the right lung one gets the impression of the fusion or confluence of a large number of irregular densities interspersed with small areas of emphysema. Upper one-third of the right lung shows large areas of emphysema. No pleural reaction."

Sequence: The patient died five days after entering the hospital. Permission for autopsy was not obtained.

Clinical Impression: Chronic bilateral tuberculosis and mycosis. From an x-ray standpoint, we feel the predominating densities are more characteristic of mycosis than of tuberculosis.

CASE 5: F. S., white farmer, age 39. The patient gave a history of a hacking cough for a long time and of pleurisy seven years before admission. He had lost weight and experienced pain in the right shoulder in the last twenty-one months. Eight months ago there had been drainage from the mid-part of the right arm. Two brothers died of tuberculosis, one several years earlier and one two years ago. A roentgen film of the chest made elsewhere in 1941 showed chronic fibroid apical tuberculosis of questionable activity. No tubercle bacilli could be found in repeated examinations of the sputum at that time. The chest was re-examined roentgenographically in 1942 in the same laboratory,



Fig. 5. Case 4: Bilateral tuberculosis and mycosis. Roentgenogram showing confluent nodules and areas of emphysema.

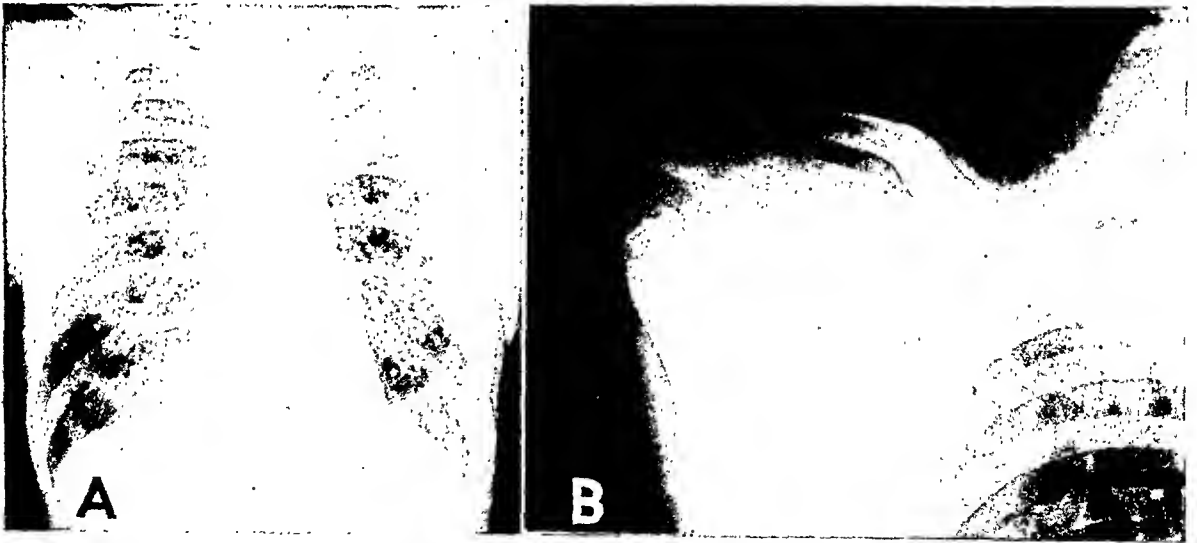


Fig. 6. Case 5: Roentgenogram of chest (A) showing mycotic or tuberculous or mycotic and tuberculous lesions and (B) of shoulder showing mycotic infection.

and a report was made of "bilateral pulmonary tuberculosis—possibly active." No report was obtainable as to sputum examination. Further x-ray study in May 1943 showed "far advanced pulmonary tuberculosis, bilateral and active."

The patient was emaciated, weighing only 119 pounds. The temperature was 100.3°; pulse 96; blood pressure 105/70. There was severe pain on motion of the right shoulder but no swelling. In the mid-portion of the right arm mesially was a draining

sinus, with a discharge of thin, straw-colored, granular fluid. Moist râles were present in both lungs, but especially in the left.

The blood showed hemoglobin 12.5 gm.; red cell count 5,200,000; white cell count 16,300 (76 per cent polymorphonuclears). Smears from the sinus exudate showed masses of yeast. Culture showed a moderate growth of yeast in twenty-four hours. The sputum showed yeast and many tubercle bacilli. Examination of a guinea-pig six weeks



Fig. 7. Case 6: Miliary soft-tissue shadows throughout both lungs, attributed to mycosis.

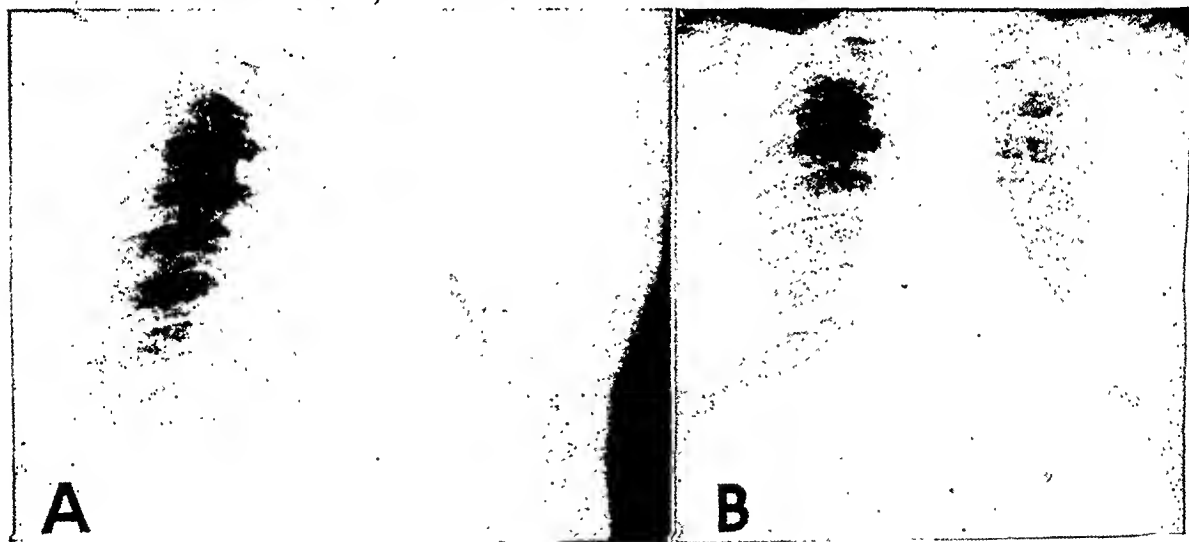


Fig. 8. Case 7: A. Mycotic lesions in right base; traumatic pneumonia in left lung. B. Roentgenogram made two months later, showing resolution of pneumonia; the lesions in the right base persist but are improved.

after injection of the sinus fluid intraperitoneally showed no evidence of either yeast or tuberculosis.

Roentgen films of the chest (Fig. 6A) revealed irregular soft-tissue nodules scattered diffusely throughout both lung fields. These varied in size from 1 to 7 or 8 mm. in diameter, and were especially prominent in the right base. Areas of fibrosis were seen in both apices, as well as possible small cavities. Throughout the left apex and lateral to the right hilum were irregular millet seed-like calcifications. The heart was hypoplastic. X-ray examination of the right shoulder (Fig 6B)

showed destruction of the head of the humerus without decalcification of the contiguous bone. The greater part of the glenoid fossa was also destroyed. There was no evidence of ankylosis. No proliferative changes were observed.

Clinical Impression: Active bilateral pulmonary tuberculosis of both apices. Mycotic or tuberculous, or mycotic and tuberculous infections of both lungs otherwise. Mycotic non-tuberculous infection of the right shoulder.

Sequelae: The patient improved and gained ten pounds in weight under potassium iodide therapy over a period of two months and then lost weight through inability to eat while taking large doses of the drug. At the time of this report the shoulder shows much less drainage but also shows secondary pyogenic infection. The potassium iodide was stopped and the patient is again enjoying his food. Both lungs show definite improvement.

CASE 6:⁵ F. B., white farmer, age 70. The patient had never been ill except for the usual children's diseases. About three weeks before admission he became unusually weak and tired, with loss of appetite. He had no cough.

The patient was rather thin and emaciated, with badly infected teeth. The lungs showed a few

coarse bronchial râles. The heart tones were soft but otherwise not unusual. Temperature 103.4°; pulse 95; respirations 20.

The blood showed hemoglobin 14.5 gm.; white cell count 8,650; red cell count 4,500,000. The urine showed 2 plus albumin. The sputum was negative for tubercle bacilli, and a blood culture was negative after forty-eight hours. Sputum cultures were negative for tubercle bacilli. No culture was made for yeast.

⁵ Reported through the courtesy of Wm. Schiele, M.D., Galena, Ill.

A roentgen film of the chest (Fig. 7) showed diffuse miliary soft-tissue shadows scattered throughout both lungs, but more in the right than in the left.

Clinical Impression: In view of the failure to demonstrate any tubercle bacilli, we feel that the x-ray findings justify a diagnosis of probable pulmonary mycosis.

Sequelae: The patient died seven days after entering the hospital.

CASE 7: F. A., white male, torch operator, age 61. The patient had always been well except for a fracture of the right tibia several years ago. Two days previous to being seen he fell from a ladder, lacerating his scalp. No skull fracture could be demon-

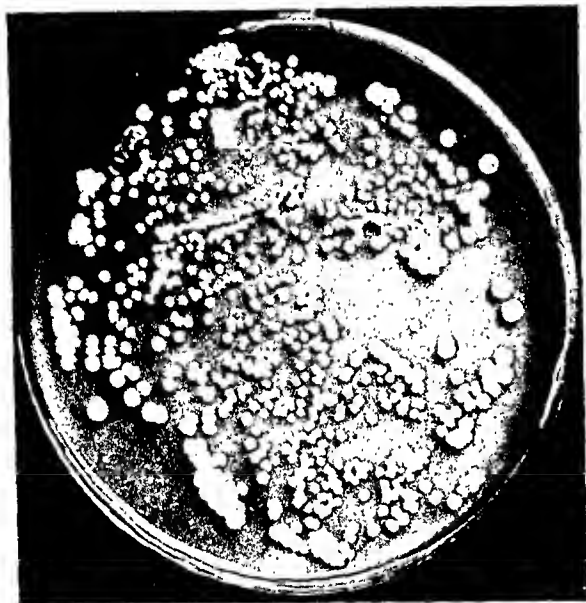


Fig. 9. Case 8: Yeast colonies grown in Sabouraud medium.

strated. He was sent to the hospital because of pulmonary lesions.

The patient was stout and appeared somewhat cyanotic. Temperature 105.4°; pulse 90; respirations 36; blood pressure 156/80. There were coarse râles throughout both lungs with dullness on the left.

The blood showed hemoglobin 82 per cent (Sahli); white cell count 12,750 (57 per cent polymorphonuclears). The urine showed albumin 25 mg. Smears of the sputum revealed a rare leukocyte, a few staphylococci, an occasional short chain of streptococci, and only a rare pneumococcus, too rare to type. Organisms suggestive of a fungus were fairly numerous. Culture of the sputum showed an abundant growth of yeast colonies, classified by N. F. Conant, M.D., as belonging to the type *Monilia pseudotropicalis*.

A roentgen film of the chest (Fig. 8) revealed consolidation of the entire left lung, except for an



Fig. 10. Case 8: Probable mycotic and bronchiectatic lesions.

area just below the left hilum, and displacement of mediastinal structures to the left. There were increased bronchovascular markings in the right base.

Sequelae: The temperature returned to normal on the third day after admission and the patient left the hospital on the thirteenth day, feeling fine.

Clinical Impression: Post-traumatic atelectasis and pneumonia; bilateral mycotic infection of the lungs as an incidental finding.

CASE 8: J. S., white mail carrier, age 70. The patient had not been in good health for twenty years. He had always raised a lot of purulent and offensive sputum and was confined to bed several times each year with lung infections. Roentgen films several years previously showed extensive bilateral abscesses. One quart of cloudy straw-colored fluid was aspirated from the right chest in 1938. The present illness began three weeks before admission, with chills and fever. The patient coughed up continuously a profuse amount of foul, purulent sputum. He had no appetite and had been losing strength rapidly.

The patient was emaciated, breathing rapidly, giving the appearance of being seriously ill. The chest was emphysematous. The lungs showed impaired resonance at each base with moist râles throughout. The heart tones were pure and the action was rapid but regular. Temperature 102.4°; pulse 120; respirations 35.

The blood showed 68 per cent hemoglobin (Sahli); red cell count 3,780,000; white cell count 27,800

(75 per cent polymorphonuclears). The urine showed albumin 20 mg. per cent and a few granular casts. There were numerous pus cells in the sputum, with a few gram-positive cocci, some of which tended to form chains while others appeared intracellularly in clumps. No acid-fast organisms were found. Cultures showed staphylococci and streptococci. Culture on Sabouraud medium after three days showed a profuse growth of yeast colonies, as illustrated in Fig. 9.

The report of roentgen examination of the chest, just previous to the patient's entrance into the hospital was as follows: "Bizarre, fuzzy shaped densities throughout the entire right lung and the lower lobe of the left lung. The densities vary greatly in degree and size. Small, thin-walled cavity adjacent to the parietal wall beneath the third rib on the right side. Marked thickening of the pleura over this region. Marked secondary emphysema throughout the uninvolved portion of both lungs. X-ray conclusion: Bilateral chronic bronchiectasis. Type of x-ray pathology would suggest pulmonary mycosis or unresolved pneumonia as a cause."

Clinical Impression: Chronic bronchiectasis and chronic pulmonary mycosis. No evidence to show which came first.

Sequelae: Patient died three days after entering the hospital.

CONCLUSIONS AND SUMMARY

1. Classification of yeast infections is a difficult procedure and one to be undertaken only by those with considerable experience and with facilities with which to study fully cultural and morphological characteristics.

2. A review of the literature dealing with mycotic infections of the lung demonstrates little, if any, difference between the history, physical findings, pathology, and sequelae of the various types of yeast infection.

3. The recognition of possible yeast infection is in great part the responsibility of the roentgenologist, and it is also his duty to stimulate any further study required to eliminate or prove that possibility.

4. The reported cases demonstrate some of the difficulties encountered in evaluating the importance of yeast in the sputum. There may be a pure infection; there may be a secondary infection which assumes a primary role in extension of the original disease, the secondary disease, or

both; the yeast may be an incidental finding of no clinical significance; it may be a contaminant from a receptacle unless proper precautions are used.

5. We feel, from a limited experience, that yeast infections are much more prevalent than ordinarily thought. As proved in the literature and in the cases reported, too many mycotic infections go unrecognized until shortly before a terminal condition exists. It is hoped that this paper may encourage research to find an early means of diagnosis and stimulate a consideration of mycotic infections in the differential diagnosis of diseases of the respiratory tract.

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Fungus Disease of the Chest¹

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FUNGUS INFECTIONS are not rare in man. While the skin is the most usual site of inflammatory reaction, the lungs and bones are frequently involved. This paper presents a group of proved cases of infection of the lungs due to *Coccidioides*, *Actinomyces*, *Aspergillus*, *Monilia albicans*, *Torula*, and *Blastomy-*

lymphatic systems, as well as the supportive framework of the lung and chest. An acute inflammatory lesion of the lungs is recognized by its uniform density, exudative in character. Later, as the lesion stimulates the production of fibrosis or leads to a cavity formation or varies in density because of a spread or clearing of

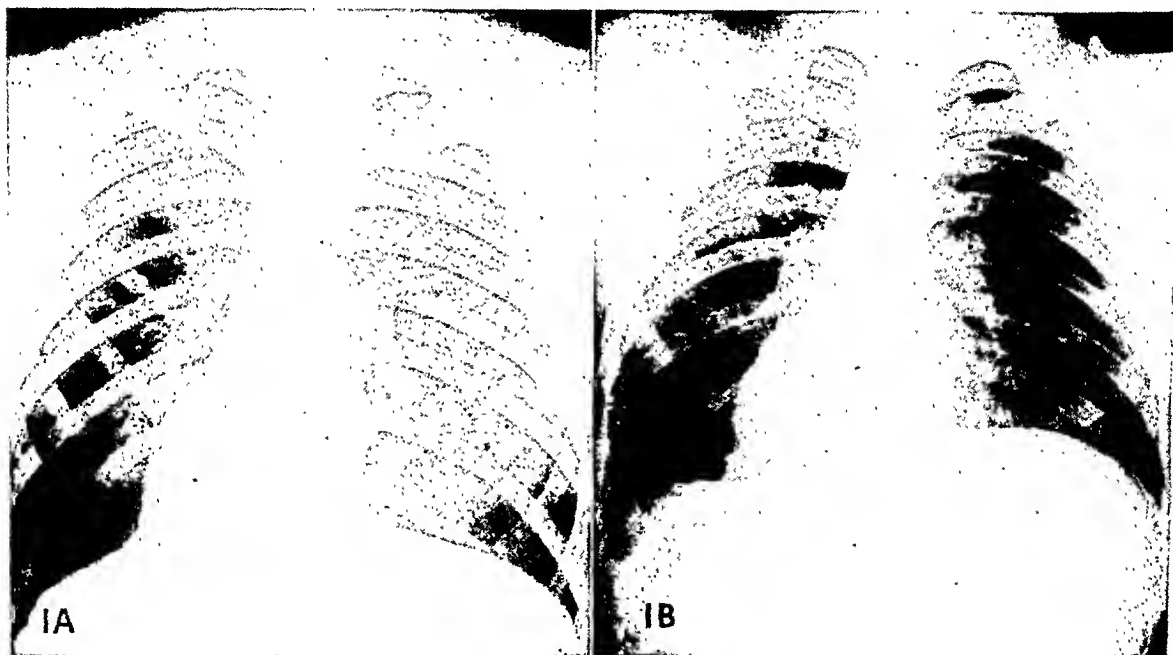


Fig. 1A and B. *Coccidioidomycosis*: A. Local exudative infiltration, right lower lobe, with thin-walled cavity. B. Irregular exudative infiltration, left upper lobe, with thin-walled cavity.

ces. In approximately one-fourth of these cases there were fungus infections elsewhere in the body when the patient was first seen. The presence of extrapulmonary lesions is an aid in the differential diagnosis of the lung lesion. A careful correlation of the clinical evidence of disease along with the roentgen evidence will usually enable the physician to make an accurate diagnosis.

The roentgen diagnosis of pulmonary disease is based upon the variation from normal of the ventilating, vascular, and

the exudative reaction from the periphery, it is recognized as chronic in nature. In addition, certain lesions involve the bronchi or the alveolar portion of the lung primarily and are situated in characteristic locations in the lung fields. It should be noted in fungus infections that the clinical history may be of little value and that the radiographic picture may simulate any type of known inflammatory process in the lung. At times, the lesion may resemble metastatic or primary carcinoma, lymphoblastoma, or leukemic infiltration.

For these reasons it is impossible in many cases for the clinician to arrive at an accurate diagnosis without additional in-

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

formation. The radiologist should be of considerable aid, in that he may suggest the probable etiological agent so that cultures and microscopic studies may be made of material from the lesions. In addition, skin and blood agglutination tests may be of value. In general, the diagnosis of fungus infection should depend upon the finding of the fungus in material from the lesion and the absence of other organisms that could be responsible for it.

Fungi are often secondary invaders in cases of bronchiectasis and other chronic lesions of the lung. The improvement noted in certain cases of bronchiectasis following iodide therapy may be due in part to clearing of the secondary fungus infection.

COCCIDIOIDOMYCOSIS

Twenty-four cases of coccidioidomycosis were diagnosed and confirmed by culture of the causative agent, *Coccidioides immitis*, from the sputum or by positive skin or agglutination tests on the blood. The latter were performed by Smith (1). Four of these patients had additional lesions involving bones. One died of a miliary infection.

The roentgen evidence of pulmonary disease found in these cases varied considerably. The most frequent lesion was a solitary nodose area of infiltration that later broke down leaving a thin-walled cavity. Such lesions ranged in size from those which were barely visible to some several centimeters in diameter (Fig. 1). At times the nodose lesions were scattered throughout the lung so that they gave the appearance of metastatic carcinoma. In other instances, they resembled very closely lesions due to tuberculosis, involving one or both apices or the mid-lung field (Fig. 2). Two cases showed both parenchymal and pleural involvement (Fig. 3). Approximately half of the patients showed slight enlargement of the hilar lymph nodes adjacent to the lung infiltrate.

These cases were observed over periods varying from two months to one year.



Fig. 1C. Coccidioidomycosis: Local exudative infiltration, left upper lobe, with cavitation.

During this time, the infiltrative lesions cleared slowly, with only slight if any change in the size of most of the cavities present. The histories given by the patients were indefinite. All were from stations in the southwestern United States, chiefly California. Several gave a history of an influenza-like fever that was undoubtedly "valley fever" (2). There was little clinical evidence of disease in the greater number at the time of hospitalization.

Carter (3) described a higher proportion of diffuse infiltrative lesions in relation to the number of cases examined than seen in the small series reported in this paper. Winn and Johnson (4) demonstrated the presence of residual bronchiectasis as well as cyst-like cavities resulting from coccidioidomycosis. The latter were demonstrable in the cases observed here. Lipiodol studies were not made to detect the presence of bronchiectasis, but a number of these patients would undoubtedly show bronchial dilatations.

Aronson and his associates (5) studied a group of persons showing areas of lung fibrosis with associated calcified nodules who gave positive coccidioidin skin tests

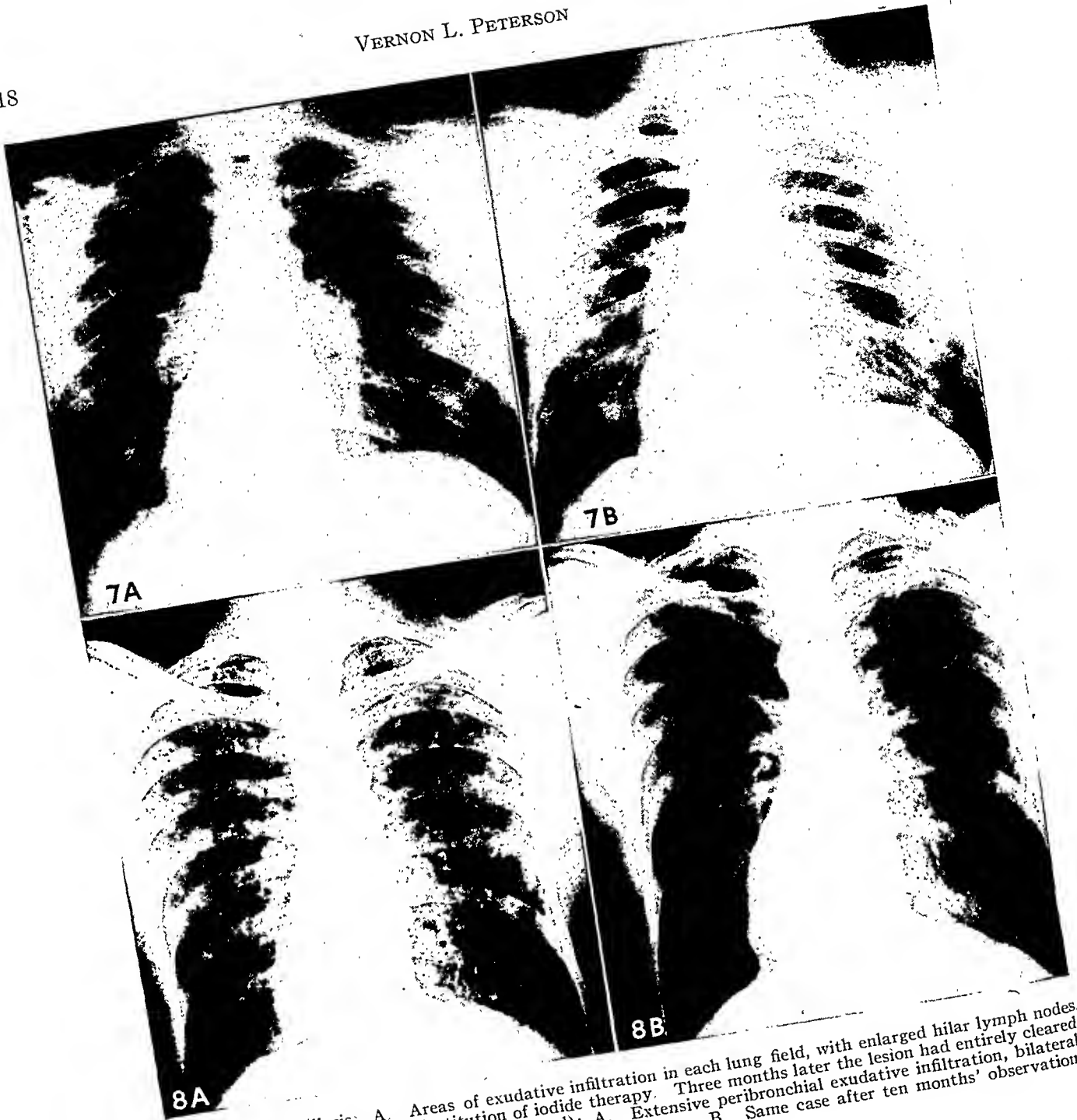


Fig. 7. Aspergillosis: A. Areas of exudative infiltration in each lung field, with enlarged hilar lymph nodes. B. Same case four weeks after institution of iodide therapy. Three months later the lesion had entirely cleared.

Fig. 8. Aspergillosis (diagnosis not confirmed): A. Extensive peribronchial exudative infiltration, bilateral and fairly symmetrical in the two lungs; areas fairly discrete. B. Same case after ten months' observation, showing noticeable clearing.

tration cleared, leaving only a slight residual reaction at the end of twelve months (Fig. 8).

In this type of case, if repeated sputum tests for tubercle bacilli are negative, one may be justified in suggesting iodide therapy and basing the final diagnosis on the response to the treatment. Fawcitt (7)

gives an excellent discussion of this and similar fungus infections in England. Many roentgenograms have been examined in which multiple irregular areas of calcification are seen in the lung parenchyma and in the hilar lymph nodes. These cases may or may not have a negative tuberculin test. This type of calci-

fication is regarded as the residual of a healed fungus infection (Fig. 9).

MONILIA ALBICANS

Monilia albicans is a fungus commonly harbored by man and frequently a secondary invader in pulmonary disease. It also has the distinction of occasionally produc-



Fig. 9. Extensive calcification in each lung. Tuberculin skin test was negative. No history of illness.

ing primary lung lesions. Four such instances have been observed in this study.

The lesion as demonstrated by x-ray was primarily a diffuse peribronchial infiltration, bilateral and fairly symmetrical on the two sides. One case showed a bilateral apical exudative infiltration with similar infiltration opposite the right mid-hilum area. This later resolved and broke down with resultant cavity formation (Fig. 10). If treated, the lesion resolves rapidly, with residual fibrosis.

TORULOSIS AND BLASTOMYCOSIS

Torulosis and blastomycosis are rare in man. They usually produce parenchymal lesions similar to those seen in tuberculosis. Cases have been reported in which extensive infiltration was present (Carter, 8).

One case of blastomycosis was observed

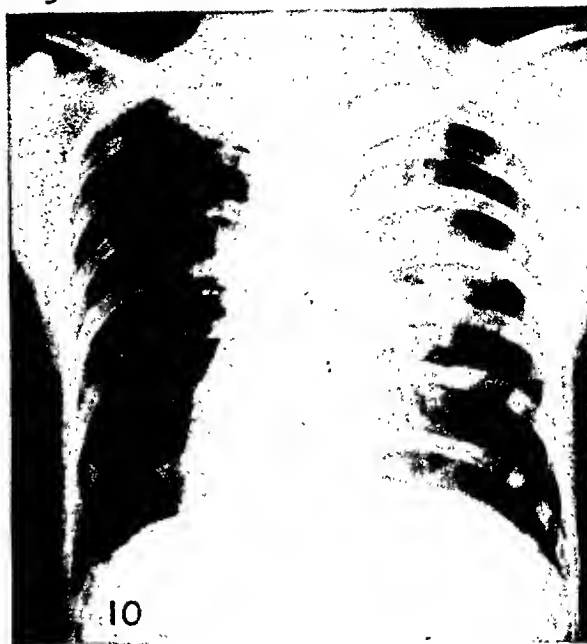


Fig. 10. Moniliasis: Exudative infiltration in each apex and opposite right upper hilum, with cavitation. Lesions healed rapidly, with residual fibrosis.

over a period of six years, in which there were small infiltrative lesions in the upper lung field diagnosed as tuberculosis despite repeated negative sputum tests for tubercle bacilli. The patient died of a miliary spread which at autopsy was found to be caused by the fungus. A case of torula infection was also observed. This showed infiltration in the right mid-lung with pleural involvement (Fig. 11). The patient recovered following therapy and drainage of the pleural fluid.

DISCUSSION

Fungus infections of the lungs are not common. When they do occur, it is important that an early diagnosis be made before extensive damage occurs, as many of the lesions will respond rapidly to therapy.

A wide variety of lesions, as seen by x-ray, may be produced. Many, however, show a somewhat similar picture, which if familiar to the radiologist will lend speed to the diagnosis and subsequent treatment.

The final diagnosis must rest in most

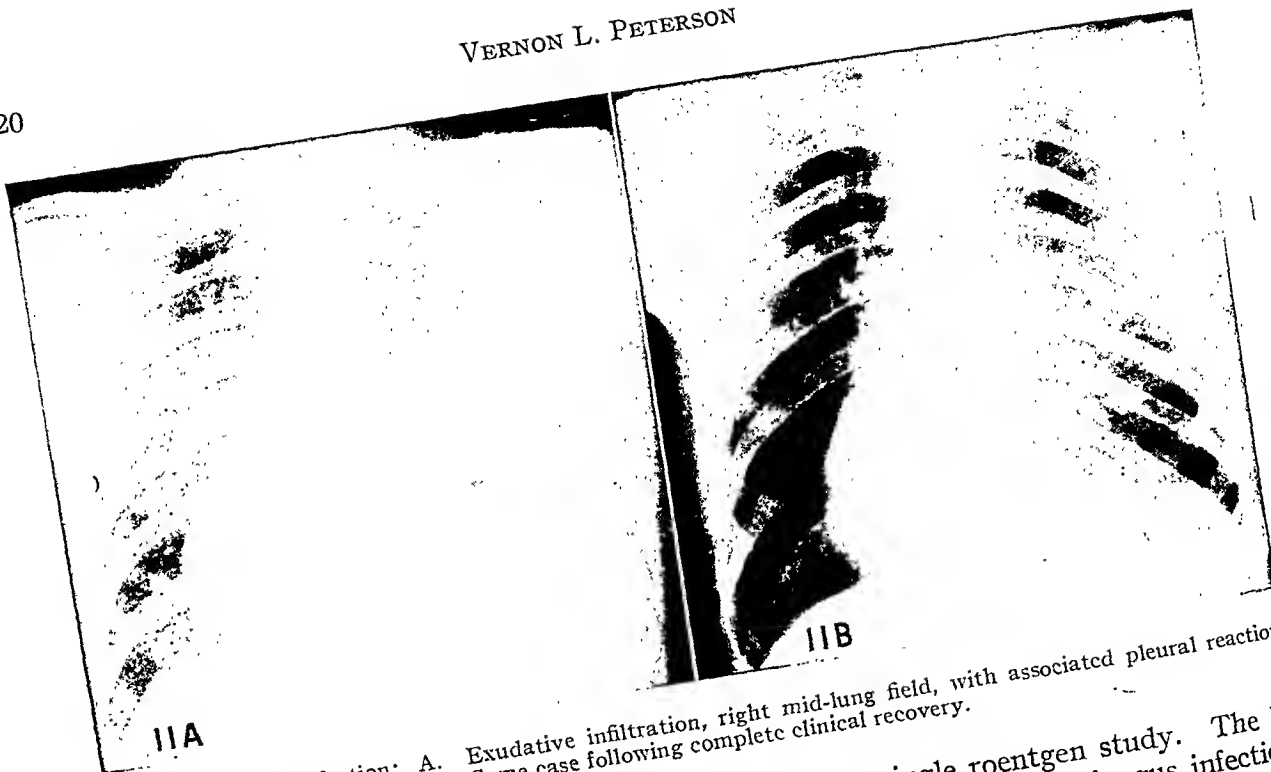


Fig. 11. Torula infection: A. Exudative infiltration, right mid-lung field, with associated pleural reaction. B. Same case following complete clinical recovery.

cases on the isolation of the causative fungus as well as the absence of other etiological factors. The lesions most often resemble a tuberculous infection. Any lesion having the appearance of tuberculo-sis in which no tubercle bacilli can be found should be studied carefully to rule out a fungus infection. In patients in whom no definite organisms can be isolated, a therapeutic test with iodides may be instituted and the final diagnosis based on the response.

It is probable that many of us will see our first cases of fungus infection due to Coccidioides as men are returned from Army camps. It is important that these lesions be recognized and that the patient be not required to abandon his occupation in every instance, since the course tends to be benign.

SUMMARY

A brief presentation has been made, with discussion, of observations in cases of fungus infections due to Coccidioides, Actinomyces, Aspergillus, Monilia albicans, Torula, and Blastomyces. There is no specific criterion for diagnosis on the

basis of a single roentgen study. The lesions in a given type of fungus infection, however, do have a similarity, and the radiologist can be extremely helpful if he will familiarize himself with the findings so that he can suggest the probable diagnosis.

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Roentgen Therapy of Sinusitis, with Special Adapter¹

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ROENTGEN THERAPY has assumed an increasingly important position in the treatment of sinusitis and its varied associated complications. Far too many cases of so-called head cold are given minor consideration, though the majority of these lasting more than a few days probably result in acute sinusitis. In many instances healing is never complete, and mild exposures, fatigue, and upsets of the acid-base balance reactivate the dormant infection, producing a so-called fresh or new head cold.

While sinusitis knows no age limit, it is well to remember that the antra are the only air sinuses which are more than rudiments at birth (Keith, 1). Some of the other sinuses begin to form at that time. The sphenoidal and ethmoidal groups continue to grow until the twenty-fifth or thirtieth year. Piersol (2) states that the frontal sinuses develop about the seventh year. One need not look for frontal sinusitis, therefore, before the age of seven. All of the sinuses undergo active development during puberty.

As to types of sinusitis, the classification outlined and followed by Hodges and Snead (3) and Firor and Waters (4) seems logical.

Rhinological examinations are of paramount importance in determining the indications for treatment. Patients with anatomical malformations, such as severely deflected septum, malformations of the turbinates interfering with sinus drainage, tumors including polyps, empyema, antral abscesses of dental origin, etc., should not be given x-ray treatment except in conjunction with other proper rhinological procedures. Empyema of the antra requires surgical drainage.

The etiology of sinusitis has received

but meager consideration in recent radiologic literature. Inasmuch as cases requiring x-ray treatment are usually of the subacute and chronic hyperplastic variety and such chronicity is admittedly a sequence to repeated colds and acute sinusitis, more stress ought perhaps to be placed upon the investigation of the causative factors.

Van Alyea's recent book (5) on *Nasal Sinuses* contains much valuable material, including Jarvis' classification of twelve varieties of the common cold. Van Alyea states that acute sinusitis is due to a continuity from acute rhinitis and that nasal accumulated contents or pus may be forced into the sinuses by *blowing* or *sneezing*. Hitz (6), many years ago, called attention to the pernicious habit of head cold sufferers who attempt to "blow the cold out" by force, thereby forcing the infection into the sinuses or middle ear. We are all familiar with the "ear click" during a suppressed sneeze or "fog-horn" blowing of the nose. Unless patients are taught how to avoid such baneful habits, repeated attacks of sinusitis may follow. Van Alyea quotes Kelley's findings in a study of allergy in 100 patients with asthma. Of these, 89 per cent had sinus infection: antra 82, ethmoids 61, sphenoids 66, frontal sinuses 46 cases. The writer recently had two patients, young women, who had been treated for sinusitis, both having been subjected to minor rhinologic surgical procedures, without relief. Investigation showed the condition to be seasonal in one; who was a summer hay-fever victim, while the other was moderately allergic to feather pollen and house dust. Neither patient required x-ray treatment, but instead needed education and prophylactic measures for relief. Ebb's analysis (quoted by Van Alyea) of 495 autopsies in children up to the age of four-

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

teen years, showed purulent sinus infection in 152 cases (30.6 per cent). The antra were most commonly involved. Frequently one sees a child who has been subjected to adenotonsillectomy for repeated head colds without relief of symptoms. Investigation usually reveals sinusitis, often associated with persistent cough. If more than 30 per cent of children who die show the presence of suppurative sinusitis, certainly sinus infection needs more careful consideration.

Symptoms of sinusitis are necessarily varied, depending upon the nature of the infection, the sinuses involved, the reaction of the host, etc. Nasal or choanal discharge, especially if persistent, the dull nasal voice in pansinusitis, the *varied headaches* relative to the sinuses involved, the repeated attacks of rhinitis and their tenacity, the frequently associated cough, are symptoms which, if they refuse to respond to the usually successful treatment, should prompt sinus investigation. Patients who awake in the morning with headache and postural headache sufferers are good subjects for careful sinus study. Too many headaches that cannot be readily explained are labeled "migraine headache" and the patient is given a powerful analgesic and told that he has a hereditary disease for which there is no cure. Several years ago a plasterer, aged thirty-two, consulted me for "migraine headache." The attacks, which came on suddenly, were severe and disabling. Roentgen examination revealed clear sinuses but a badly impacted upper wisdom tooth. Removal of the tooth was advised, and following this the patient suffered no more from his "migraine."

Diagnosis of sinusitis requires a careful rhinological examination. The tell-tale pharyngeal discharge and the nasal discharge are significant. Transillumination, if done properly, is the simplest test for information as to the condition of the sinuses. I am suspicious of the examiner, however, who proceeds to transilluminate a patient without much the same preparation that is needed for fluoroscopic exami-

nation. The room must be dark (black) and the operator must allow time for accommodation of his eyes to the darkness. True, one cannot tell whether there is a frontal sinusitis if there is no transillumination; only the x-ray can reveal that. But the cases in which transillumination is successful need no x-ray for diagnosis. X-ray films, of course, are the final criteria. Most roentgenologists take sinus films in the prone position; yet ought not the same precautions be taken for sinus examination as for chest studies? If we want to know whether or not fluid is present in the chest, we obey the laws of hydrostatics and have the patient stand, sit, or turn on the side, to obtain diagnostic films. If more than 30 per cent of children who die suffer purulent infection in the sinuses, as has been mentioned above, more critical x-rays should certainly be taken in sinusitis cases.

The writer has found no records of the use of the fluoroscope in examination of the sinuses. For several years he has used fluoroscopy as a diagnostic procedure where transillumination indicates or shows sinusitis. A brief rehearsal with the patient before examination will shorten the time of the fluoroscopic examination to one or, at the most, two minutes, providing the examiner is properly prepared for dark-room work. Obviously, these examinations are carried out with the patient in an upright position. The usual advantages of fluoroscopy are appreciated here as the head is tilted and turned right and left in all positions. Where any pathologic changes are noted, films are made for detail studies and record, as in chest examination. The examiner must be educated to identify the various sinuses fluoroscopically. He will benefit by fluoroscopic examination of skulls until orientation is attained. The sphenoids are well displayed in the oblique position, through the orbit. Hodges and Snead (3) make a practice of routine sinus x-ray examination of all patients that come in for chest films, and thus find many unsuspected cases of chronic sinusitis.

TREATMENT

Kisch and Salmond (7) made the observation that a patient obtained relief of pain after each of three roentgen diagnostic procedures. They then gave therapeutic doses in a number of cases of chronic sinusitis, with gratifying results in seven. The acute forms of sinusitis should be treated rhinologically and constitutionally. Sulfa drugs are frequently of value. Van Alyea (5) quotes Talia, as well as Lechner and Schmidt, on the use of short-wave therapy in chronic sinusitis; Laszlo found it of more value in acute cases. The writer gives short-wave therapy in both acute and subacute sinusitis—not the septic cases—with satisfactory results in 80 per cent of cases. A wave length of 10 or 25 meters is used. Van Alyea (5) found infra-red rays of value and writes: "Often one treatment provides the impetus which promotes a healing process."

It is with the subacute and chronic hyperplastic varieties of sinusitis that the radiologists are chiefly concerned. The care with which cases for roentgen therapy are selected is a direct index to the percentage of patients relieved or cured. Anatomic deformities, as well as pathologic changes, such as tumors, polyps, empyemas, etc., must have rhinologic treatment. Headache is an almost universal complaint of chronic sinusitis sufferers. As suggested above, a headache which is present when the patient awakens from sleep is probably due to sinusitis. The same is true of postural headache. Headache due to eye strain ordinarily develops hours after work has been resumed.

Hodges and Snead (3) reported satisfactory results in the treatment of sinusitis with x-ray. They gave small doses, also, to the bases of the lungs where bronchitis and a chronic cough had resulted from chronic sinusitis. W. L. Ross (8) used multiple small doses, totaling 300 to 420 r, at 110 kv., and obtained clinical relief in a series of 121 cases. Gatewood (9) made a critical study of 22 cases of sinusitis. His analysis, after careful study

before and after irradiation, is instructive. Four patients in his group were completely relieved, 8 were symptomatically improved, and 10 showed no clinical or other improvement. (One of this last group submitted to surgery six days after x-ray treatment.)

Williams and Popp (10) report relief from pain in one to six hours in their most favorable cases. They used small doses, 50 to 100 r at low voltage.

Youngs (11) obtained his best results in children: 15 of his patients were between the ages of four and seventeen. Nine of his cases were listed as cured, 3 as improved, 3 as not improved, but a follow-up of one of his failures indicated complete relief of symptoms after one year.

Firor and Waters (4) caution against x-ray treatment in acute sinusitis and in complicated chronic forms with much fibrosis and polyp formation. They urge rhinologic treatment where indicated. In their series of selected cases (subacute and chronic sinusitis, with hyperplasia), 70 per cent were improved or cured. They used small doses at low voltage. McLendon and Rathbone (12) reported on 291 cases of sinusitis in children who were given roentgen treatment, with 83 per cent clinical improvement in 155 cases checked at the end of one year. They conclude their paper with the statement: "Roentgen therapy is a valuable method of treatment in properly selected cases."

Maxfield and Martin (13) express increased enthusiasm for irradiation in certain types of sinusitis, but stress rhinologic treatment when drainage is needed or tumors are present.

R. R. Rathbone (14) quotes Campbell's statement that in 150 cases of mastoiditis there was a coexistent sinusitis. He believes sinusitis is very common in children and refers to Clerf, who is also quoted by Van Alyea (5), as stating that 82 per cent of bilateral bronchiectasis is due to sinusitis. Rathbone does not advocate x-ray treatment in acute sinusitis and cautions against its use in purulent cases. His results in asthmatic children having frequent



Fig. 1. Old cumbersome method of arranging protective filters for sinus roentgen therapy. The x-ray stand and tube are not shown here.

and repeated colds and complications were exemplary. Some of his cases received high-voltage radiation, 220 kv., well screened, but only 100 r per dose; six treatments were usually given. Of his series of 70 patients followed for three years, 57 per cent were cured, 28 per cent improved, 15 per cent not improved.

Butler and Woolley (15), in their first major report, covering 700 cases of sinusitis treated by x-ray, were able to tabulate the results in 450 cases. Of these, 36 per cent showed complete relief, 55 per cent definite improvement, 9 per cent only slight or no improvement, which is very creditable. These authors emphasize rhinologic treatment of associated disease contributing to sinusitis.

In a later report, covering well over 2,000 treatments, Butler and Woolley (16) pleaded for a more general use of roentgen therapy in suitable cases of chronic sinusitis. They noticed in particular that complaints of headaches, neuritis, and bronchitis ceased after radiotherapy. They continued the use of a single treatment of rather large dosage and reported on a series of cases with high voltage x-rays, 200 kv., heavily filtered. For children smaller doses were used.

In 1942 Butler and Woolley (17) reported on their accumulated experience in roentgen therapy of sinusitis, covering a period of eleven years. They have continued the use of high-voltage roentgen rays with heavier filtration and 50 cm. distance, giving single treatments as recorded in their previous reports. They describe a lead mask for protection of the face, except the areas covering the sinuses. Thirty-three per cent of their cases were cured, 41 per cent improved, 26 per cent unimproved.

Kornblum (18) found a definite relationship between bronchiectasis and sinus disease. He felt that roentgenologists were too conservative and pessimistic about the treatment of the sinuses, especially where surgery is involved.

One sees but few definite instructions as to how to protect the eyes in the roentgen treatment of sinusitis. While it is a well known fact that nerve tissues are radio-resistant, one nevertheless ought to take due precautions against any and all unnecessary exposure to radiation of such highly specialized organs as the eyes. Dyke and Davidoff (19) quote Brunner's observations, in 1920, of conjunctivitis and blindness in some of their irradiated animals. They also quote Lyman, Kupalow and Scholz (1933), who found impaired vision in some of their experimental animals. Forsterlings, also quoted by Dyke and Davidoff, concluded (1906) that young animals are particularly susceptible to roentgen radiation and warned against the indiscriminate use of roentgen rays in children.

Not only is the common method of treating each individual sinus, or group of sinuses, through a small cone a time-consuming procedure, but the depth dose is reduced, and the posterior ethmoidal group of cells and the sphenoidal sinuses thus receive inadequate radiation. Some radiologists use three portals of treatment where the sphenoids and posterior ethmoids are involved.

Being impressed by the striking results of roentgen therapy in carbuncle, quinsy, and cellulitis, the writer began roentgen

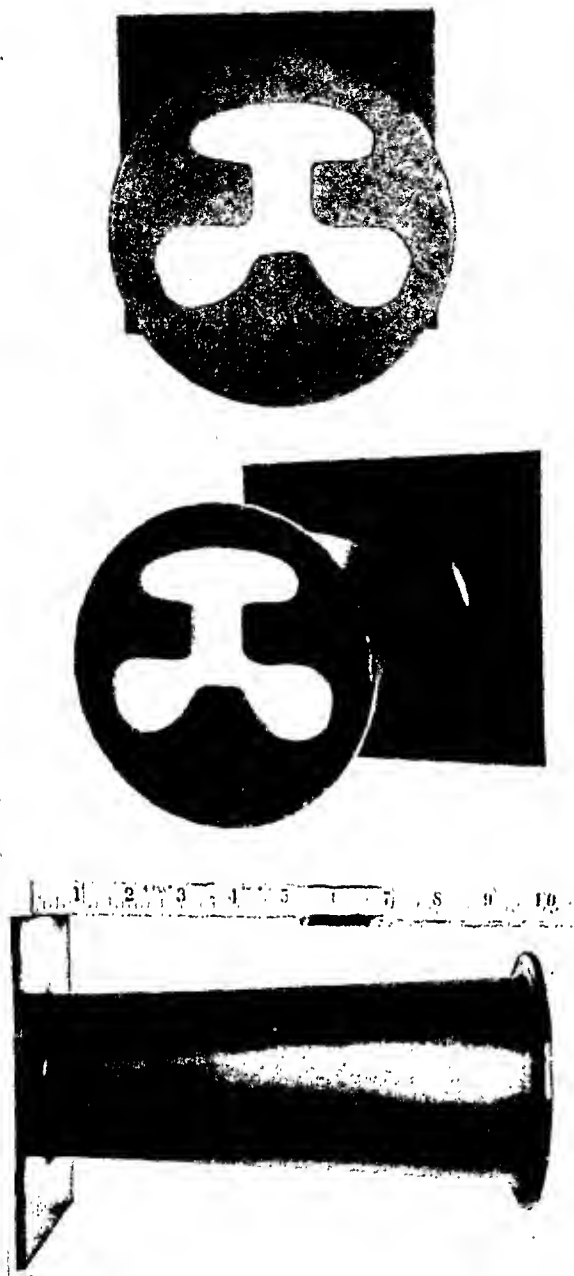


Fig. 2. Treatment cone: end view, three-quarter view, and side view.

irradiation for treatment of chronic sinusitis in 1934. (Having been subjected to puncture drainage and radical antral surgery, in 1920, he knows from personal, as well as professional, experience that radical surgery is not the answer to the problem of sinusitis.) All of the patients treated had complained of severe disabling headache. Rhinological examinations had eliminated or corrected anatomical abnormalities. Inasmuch as other inflammatory conditions

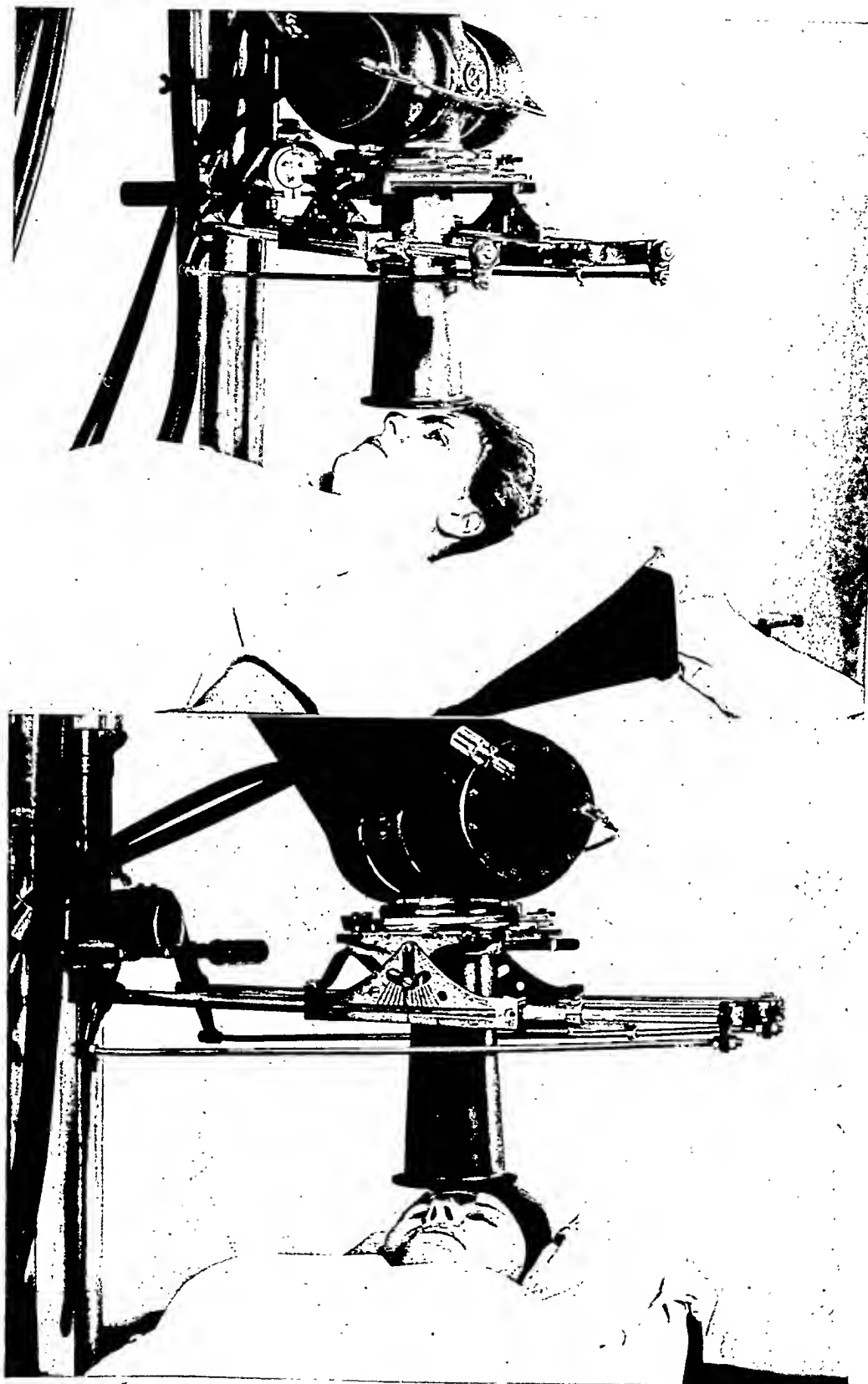


Fig. 3. Field exposed in treating with cone shown in Fig. 2. This is not a diagnostic exposure, being an anteroposterior exposure with cone in treatment position. A 17° inclined plane was used as during treatment.

reacted favorably to small amounts of x-ray (except acute surgical parotitis, where high-voltage treatment is required) small doses were given, through an anterior portal. Each eye was screened with a half dollar placed over gauze and fastened to the temples by adhesive tape. Screening off the rest of the face with leaded rubber sheets, one is constantly confronted with the problem of proper protection and at the same time of keeping the patient comfortable, so that he will not move and upset the whole arrangement (Fig. 1).

In 1939 the writer conceived the idea of placing an adequate and proper filter at the end of a 25-cm. cone so arranged that the eyes are screened and all the sinuses—and only the sinuses—are exposed to radiation at a focal distance of 40 cm. By the use of such a cone (Fig. 2), the time consumed in arranging proper filter for the eyes and eyebrows and screening off the rest of the face is eliminated; there is no weight upon the face, no fear or danger of skin contamination from case to case, no interference with respiration or the patient's comfort. Children do not fear this device. All sinuses are treated, and a better depth dose is obtained than with a small cone (Fig. 3).

Technic: The patient is placed with the head on a 17-degree inclined plane, with



Figs. 4 and 5. A 17° inclined plane is used, and the cone is in position for treatment, at 40 cm. focal distance. In the upper picture the sandbag has been removed from the left side. The lower picture is an end view of the treatment position. The sandbags along the sides of the head help to keep the patient from moving.

6A

6B

6C

Fig. 6. A. Blocking off of frontal sinuses; ethmoids and antra exposed. B. One antrum blocked off; frontal sinuses, ethmoids, and other antrum exposed. C. Both antra blocked off; frontal sinuses and ethmoids exposed.

ectasis. The patient was given two x-ray treatments to the sinuses with an interval of one week, followed by short-wave diathermy. General tonic treatment was instituted. Results were gratifying. The cough subsided and the fever disappeared. The antra remain cloudy to transillumination, but the discharge which had been present for twenty years has ceased. In August 1943, two years later, chest films showed marked improvement.

Mr. E. S., age 63, was first seen in May 1940, with almost complete obstruction of the nose by multiple polyps, and constant and profuse choanal drainage. He had severe postural headaches and frequently suffered with morning headaches.

Chronic cough had persisted for many years. Polyps had been removed several times. Rhinologic treatments were again given to clear the nasal passages of polyps. Examination revealed a pansinusitis and a chest film showed a right apical shadow, hilar adenopathy, and some bronchiectasis. Three x-ray treatments were given to the sinuses for a total dose of 450 r at 145 kv., 0.25 mm. Cu plus 1.0 mm. Al filtration, with clinical relief. Two years later there was still marked sinus dullness to transillumination but good aeration; there was no constant nasal discharge, no morning headache. There was no evidence of recurrence of nasal polyps, but recurrence is to be expected where the condition has existed for many years.

Mr. H. K., age 27, presented himself in June 1937, complaining of severe morning and postural headaches following a head cold eight weeks previously, which had never cleared. There were no rhinological abnormalities. Transillumination and x-rays showed black ethmoids and left antrum. The patient was a typical "hard nose-blower." He was given one x-ray treatment of 150 r, at 145 kv., 0.25 mm. Cu. plus 1.0 mm. Al filtration. He was completely relieved by one treatment, and when last seen, in August 1943, he stated that he had had no recurrence of headaches such as he had previously suffered and that he had had only mild colds since learning how *not* to blow his nose.

Of the other 26 patients, 11 were seen two or more years after treatments were administered. All stated that they had been free from the severe type of headache from which they had suffered. Seven patients were followed one year. All had been relieved by the x-ray treatments. Two had suffered recurrences of sinusitis and headache, and the treatments were repeated, producing clinical relief. Of the remaining 10 patients, one, a male aged 65, died of a malignant brain tumor eleven months after his sinus x-ray treatments. The tumor may have been the cause of his headache. Another patient died of pneumonia six months after x-ray treatment. The other 8 have not been followed and therefore cannot be tabulated as relieved, cured, or otherwise. Of the 18 patients followed one or more years, 7 stated that they were relieved of chronic cough. One volunteered the rather colorful statement that he was free from his cough the first morning following his initial x-ray treatment. No case in the series received more than 450 r nor more than four treat-

ments. One case received only a mild treatment of 80 r, single dose. The average number of treatments per case was three.

SUMMARY

1. The etiology of sinusitis is discussed and some of the literature on roentgen therapy is briefly reviewed.
2. Attention is called to the need for hydrostatic observation in sinus film study.
3. Fluoroscopy in sinus diagnosis has definite advantages.
4. A new and safer method for screening eyes and parts of the face, exposing the sinuses only, is described and illustrated. By this method all sinuses can be treated simultaneously, thereby saving time to both the patient and the radiologist.
5. A better depth dose is obtained by using a field which exposes all sinuses simultaneously without the danger of overlapping the exposure fields.

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Relation of Coincident Anomalies of the Gastro-Intestinal Tract and Renal Ptosis to Digestive Disturbance¹

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STUDY OF A GROUP of patients with duodenal regurgitation revealed that congenital faults of the gastro-intestinal tract and of the urinary tract, and a short first metatarsal in the osseous system, were common. The digestive tract anomalies are seldom of clinical significance but act as signposts directing attention to the upper urinary tract as the reflex cause of the gastro-intestinal symptoms.

Tixier and Clavel (1) showed by animal experimentation that traction on the renal pedicle produced definite reflex motor response in the gastro-intestinal tract. Smith and Orkin (2), inspired by that work, charted the reflex pathways over which such stimuli traveled and gave us the "reno-digestive reflex arc." We thus have the explanation of why abnormal renal mobility and silent lesions of the upper urinary tract may give rise to symptoms in the alimentary tract.

Abnormal renal mobility in women is found almost entirely in those with a short first metatarsal. Feet showing this characteristic are potentially weak and, when overused or fitted with short shoes, give rise to symptoms. Night cramps of the calf muscles are not uncommon, and the adductor longi muscles may be spastic. Study of additional cases since this paper was read shows that, if the pelvic muscles are examined, a spastic piriformis may usually be found, more often unilateral. This latter observation is important, as pressure on or massage of the piriformis may reproduce not only the low backache and suprapluteal distress which occurs in so many of these cases but also, in about 20 per cent, will give rise to an indefinite distress or sometimes fairly sharp pain across the

lower abdomen, between the navel and the symphysis pubis. Patients will state that this latter symptom is a distress or pain from which they frequently suffer and have attributed to gas. It is not the low right- or left-side pain from an overdistended kidney pelvis. One really puts his finger on the cause and exaggerates this distress if it is present or reproduces it if it is not. Gootnick (3) has discussed the mechanism of night cramps of the legs. Study seems to be indicated here to establish the "trigger mechanism" producing spasticity of the piriformis and sometimes, also, of the coccygeus and levator ani muscles, and to explain the association with abnormal renal mobility and short first metatarsals.

A series of 179 patients (61 males and 118 females) was selected for this study because of the presence of duodenal regurgitation. The age grouping is shown in Table I.

TABLE I: DUODENAL REGURGITATION: AGE INCIDENCE

Age (in years)	Cases
1-10.....	3
10-20.....	22
20-30.....	55
30-40.....	42
40-50.....	39
50-60.....	13
60-70.....	5

The significance of stasis and regurgitation has been a controversial subject. This is because the behavior patterns of the duodenum have been misunderstood. The close association of the pylorus, duodenum, and gallbladder must be recognized and they must be studied together. Delay in gastric emptying, duodenal regurgitation, gastrospasm and rapid gastric emptying require careful consideration. All of these types of functional response have been observed in this group. Albert Oppenheimer

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(4), in his study of duodenal stasis, observed that "in the presence of pylorospasm and of physiologic pyloric contraction, duodenal stasis could be produced by atropine medication, if this caused the pylorus to relax." We have found that duodenal regurgitation follows pylorospasm (or delayed gastric emptying) in a high percentage of cases and no atropine medication is required to produce it. One day pylorospasm may be present and be followed by duodenal regurgitation; the next day reversed duodenal movements may appear promptly without delayed gastric emptying. When the stomach empties rapidly, the phenomenon does not become apparent until half or more of the meal has been evacuated. If the duodenum is short, it may be difficult or entirely impossible to detect regurgitation.

In 1934, a nervous, moderately obese woman came under observation, complaining of spitting up food after every meal. Since this phenomenon has usually been attributed to a reversal of peristalsis, a systematic search of the gastro-intestinal tract was made but failed to reveal any explanation for the trouble. There was neither duodenal stasis nor regurgitation. Further questioning elicited a definite urologic history. Excretion urography showed abnormal right renal mobility. Following an argument with the referring physician as to the advisability of an abdominal support, a compromise was reached in the use of a Rose binder. Complete relief of symptoms followed, and a more permanent device was then prescribed. The patient was followed for several years and there was no relapse. As a result of the improvement in this case, five patients known to have duodenal regurgitation were examined, and all were found to have an abnormal degree of renal mobility. Since that time in the presence of duodenal regurgitation we have examined the urinary tract whenever possible. A gastro-intestinal study has also been made of many patients with frank urinary disease, and reversed duodenal movements have seldom been found. Re-

flex gastro-intestinal symptoms occur chiefly when the kidney lesion is silent.

The close relation existing between the digestive and urinary tracts, while familiar to some, is certainly not being taken into consideration by the rank and file of the profession. Attention may first be drawn to this relationship in childhood or even infancy. Nausea, vomiting, and low right-side pain may bring the patient to the hospital for appendectomy. Abnormal renal mobility in children causes reflex gastro-intestinal symptoms and associated nutritional deficiencies, with nervousness and altered behavior patterns. This is much more common than the literature indicates. The chief cause of recurrent gastro-intestinal upsets in childhood is to be found in the urinary tract. When such attacks are due to abnormal renal mobility they are relieved spectacularly by an abdominal support. Especially noteworthy is the improvement in the child's disposition. Study of a large group since this paper was originally prepared shows that reversed duodenal movements in the first decade of life are much more common than we had suspected.

The incidence of gastro-intestinal anomalies in our series of patients was impressive. These included anomalies of position of the duodenum, congenital bands and veils, arteriomesenteric compression of the duodenum, incomplete rotation of the midgut, pelvic cecum, low hepatic flexure, low splenic flexure, and redundancy. Frequently there was more than one anomaly, and often as many as five in one patient. These seldom appeared to be of any direct clinical significance.

A routine fairly extensive history was recorded in each case, and the records were compared with Kantor's tabulation of the more important symptoms of 3,000 private patients with digestive disorders (5). His study of 1,754 cases examined roentgenographically showed the incidence of adhesions of the second portion of the duodenum to be 4.8 per cent. He found no comparable figures in the literature, but

TABLE II: COMPARATIVE INCIDENCE OF SYMPTOMS IN DIGESTIVE DISORDERS IN GENERAL AND PATIENTS WITH DUODENAL BANDS (KANTOR) AND IN THE AUTHOR'S SERIES OF DUODENAL REGURGITATION

	General Incidence in 3,000 Patients (Kantor)	Duodenal Bands: 4.8% of 1,754 Pa- tients (Kantor)	Duodenal Regurgi- tation (Author's series)
Nausea	14%	44%	53%
Headaches	23	44	37
Vomiting	20	41	39
Vertigo	3	20	..
Constipation	46	54	43
Pain (upper abdominal)	28	40	41
Appendicitis (opera- tion)	17	17	36
Appendicitis, (pus, 16 operation)	8	...	...
Cholecystectomy	...	...	13 cases
Nervousness	...	...	50%

"anatomic studies of the bands in this neighborhood, *viz.*, hepatoduodenal, hepatocolic, and hepatoduodenocolic, reveal an incidence of from 15.5 to 30 per cent. Bryant has shown that the hepatocolic ligament is the most frequent congenital adhesion in both sexes and at all ages."

Space does not permit a detailed tabulation of the symptoms occurring with anomalies in various parts of the digestive tract. They are presented here as of the entire group, since we considered them to be of reflex origin. A comparison of Kantor's two groups and our duodenal regurgitation series is given in Table II.

Kantor comments that the chief significance of duodenal veils or bands is their association with a pelvic cecum. In our group a high percentage of patients with a pelvic cecum had, also, abnormal mobility of the right kidney. The renal ptosis explains the symptoms in this group and, since nephroptosis is found frequently in association with lesions in other organs, great care must be exercised that it be not overlooked. This point can be shown by several illustrative groups as follows.

DUODENAL ULCER

Of 119 patients with duodenal ulcer, 36 showed duodenal regurgitation. Urinary tract studies were made in 28 of these—24 males and 4 females—and are included in this discussion. John M. Barnes and

Daniel E. Stedem (6), in a report of 80 cases of duodenal stasis, express their belief that the delay in transit through the duodenum bears a causal relationship to ulcer. Andrew C. Ivy (7) writes: "Reverse movements of the duodenum will in all probability be found to be associated with any condition that increases the irritability of the duodenal mucosa or musculature." Our 28 ulcer patients with regurgitation formed only 16 per cent of the 179 cases under discussion. If the concept of Barnes and Stedem is correct, one would have expected the incidence of ulcer to be higher. It is interesting to note that three of the patients had been examined three, four, and five years, respectively, before the ulcers occurred. At that time regurgitation was present but no ulcer. After the ulcers were discovered, no reverse movements were seen.

Coincident renal mobility has been found in all of our ulcer cases with duodenal regurgitation in which an examination of the urinary tract was made. Of 6 consecutive patients previously operated upon, with recurring duodenal ulcers, all had marked right renal mobility.

Nausea alone is uncommon in unobstructed post-pyloric ulcer but is common in renal mobility. Constipation is frequent in ulcer and to it the patient ascribes his trouble. Constipation is frequent, also, in renal ptosis. Hypertension is frequently associated with duodenal ulcer and may be of renal origin. Fatigue, worry, and infection, common with renal ptosis, are said to be underlying causes of duodenal ulcer.

ARTERIOMESENTERIC COMPRESSION

Twelve patients (8 females, 4 males) showed evidence of arteriomesenteric compression. The symptoms were not constant except in one male, who failed to respond to medical and postural treatment. The others were relieved by an abdominal support. The assumption was that the apparent obstruction in these cases was of minor importance, while the duodenal regurgitation was reflex from the kidney

rather than the result of a drag by the colon or the mesentery of the small gut (arteriomesocolic or arteriomesenteric compression).

In the single exceptional case operation was required. This patient was eighteen years of age and had had symptoms since childhood, which were growing constantly worse. He could no longer keep up with his school work. The occlusion was found to be due to a fold of mesentery of the small intestine displaced into the pelvis minor. Renal mobility was not present.

GALLBLADDER DISEASE

Experimental work reviewed by Ivy (7) has shown that reversed duodenal movements cause stasis of bile in the gallbladder. Duodenal regurgitation, an underfunctioning gallbladder, a spastic colon, and renal mobility form a combination of findings frequently observed.

Thirteen patients in this series who had had the gallbladder removed without complete relief of symptoms were found to have a coincident renal ptosis. All but 3 obtained relief from an abdominal support. One of the 3 was relieved by right nephropexy and the other 2 required bilateral kidney fixation. The last patient was interesting in that she experienced relief of hypertensive after fixation of the second kidney. She was evidently of the orthostatic hypertensive type described by W. S. McCann (8). Since not all of our patients with so-called residual symptoms following cholecystectomy showed duodenal regurgitation, the number of cases due to renal ptosis included here is not so large as it would otherwise have been, *i.e.*, 23.

Renal ptosis is common with gallbladder disease. It seems strange that the surgeons have not added renal mobility to the causes of "residual symptoms" following cholecystectomy. Nausea is not a symptom of chronic gallbladder disease unless there be distention of the ducts or the gallbladder. When nausea is present, a lesion of the upper urinary tract should be suspected.

Are the symptoms of the fair, fat,

flatulent female of forty of gallbladder or of renal origin?

FLATULENCE AND AEROPHAGIA

Varying degrees of aerophagia and flatulence were present in 40 per cent of this series. The most extreme case was that of a woman of thirty-one brought to the hospital for an acute abdominal condition. She was suffering from an acute aerophagia, with enormous distention of the stomach and small and large intestines. After decompression, a gastro-intestinal study was made and duodenal regurgitation was observed. Excretion urography revealed bilateral third-degree renal ptosis. The exciting cause of the acute episode was the sudden death of a grandmother who lived in the patient's home.

OTHER CONDITIONS

Three patients with gastric carcinoma without pyloric obstruction, in which nausea was an annoying symptom, were shown to have hydronephrosis of moderate degree with marked right renal mobility. One other patient with gastric carcinoma recently examined, without either nausea or duodenal regurgitation, also showed abnormal right renal mobility.

One case of diabetes, with pernicious vomiting, was given a urologic study. A right hydronephrosis with nephroptosis was shown to be present. The patient was relieved when appropriate treatment of the kidney was applied.

A member of our hospital staff, Captain E. E. Erhard, serving with the Air Corps, advises me that air sickness is most common in the group of easy vomiters. The easy vomiters of this series were found to have a pelvic cecum and a low right kidney.

In one Army Hospital, a review of 500 consecutive gastro-intestinal examinations revealed demonstrable organic lesions in only 15 per cent. Since 8 per cent of men have nephroptosis (not the usual 1 or 2 per cent of our textbooks), it seems probable that many members of the armed forces with gastro-intestinal symptoms are

actually suffering from urinary tract abnormalities.

SUMMARY

Duodenal regurgitation is said by some physiologists to be normal and of no clinical significance. We have found it in only 10 per cent of our routine gastro-intestinal studies.

An analysis of the x-ray findings and the histories of 179 patients with duodenal regurgitation has been made. Gastro-intestinal anomalies were present in 80 per cent and significant renal mobility in 72 per cent. The chief factor in the production of reflex gastro-intestinal symptoms is not the degree of renal mobility, but the nervous response to traction on the renal pedicle.

Renal ptosis is common, is frequently coincident with other diseases, and may alter the clinical picture.

The more important extra-urinary symptoms of renal ptosis are disturbances of the digestive tract, such as nausea, vomiting, constipation, flatulence, nervousness, and fatigue. These have been shown to be the chief symptoms in the group discussed.

Duodenal regurgitation has been found most often in association with or reflex

from disease of the upper urinary tract. Duodenal regurgitation has become for us an indication for study of the urinary tract also. Some of our best examples of nervous indigestion have been found in this group. These were entirely relieved either by an abdominal support or by placing another scar, not on the belly, but on the back, where it should have been in the first place.

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Diagnosis and Treatment of Osteoclastoma¹

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DIAGNOSIS

OSTEOLASTOMA, known also as myeloid sarcoma, myeloma, and giant-cell sarcoma, shows a typical radiographic appearance, usually in the extremity of a bone of a young adult, more commonly in the lower end of the radius, femur, or

At this stage, but not before, a periosteal reaction in the form of a thin periosteal accretion of new bone may be delineated. Ultimately this bony wall may be completely absorbed. The subarticular bone appears to be more resistant and the articular cartilage is usually still intact when

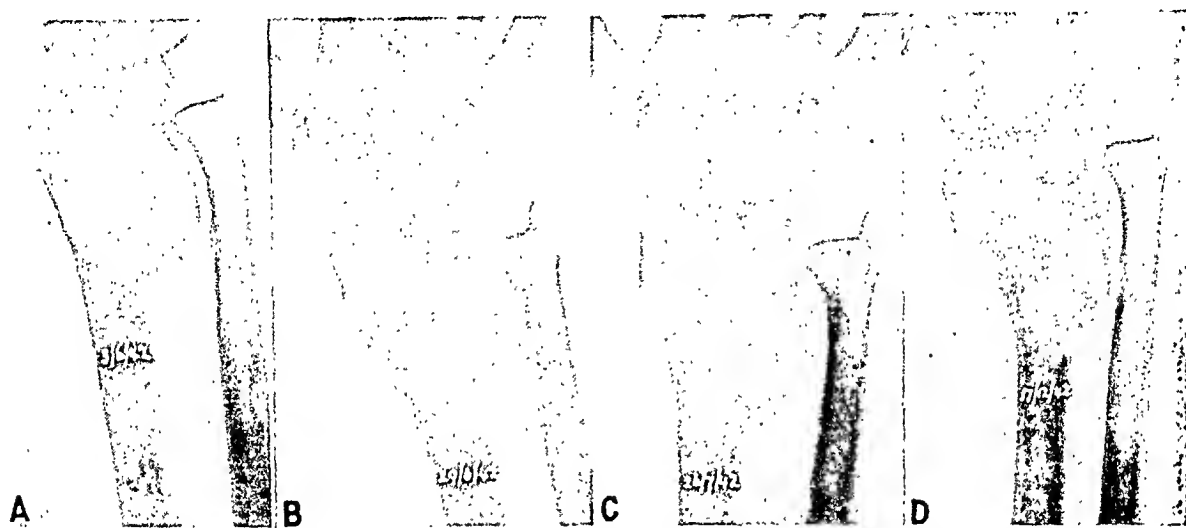


Fig. 1. A. Radiograph showing osteoclastoma at the lower end of the radius (June 3, 1942). B. Radiograph of same case three weeks after roentgen therapy (June 29, 1942). C. Radiograph of same case seven weeks after roentgen therapy (July 26, 1942). Note apparent extension of the tumour and absorption of trabeculae and bony shell. A fracture of the thin shell has occurred. D. Radiograph of same case six months after irradiation (Dec. 17, 1942). Note re-ossification of tumour site. Function now good. The good result has been maintained (November 1943).

tibia, or in the upper end of the tibia, though it has been seen at many other sites. As it progresses, the tumour slowly dissolves the bone. It does not infiltrate in the way sarcoma does, consequently the adjacent bone retains its normal characters and its borders show no increased density to indicate reaction. The line of demarcation between tumour and normal bone is often clearly defined. As the former extends, the bony wall beneath the periosteum is gradually dissolved and, when reduced to a sufficient thinness, bulges with the expansion of the tumour.

¹ Read before the Moynihan Club in September 1943. Accepted for publication in December 1943.

the tumour is first detected. As a result of the decalcification, the stability of the bone is impaired and spontaneous fracture may be the first indication of the presence of the tumour. Disuse or infection may produce additional changes in the radiographic picture.

There are certain lesions of bone which present radiographic features which may be mistaken for those of this tumour, *e.g.*, multilocular cyst, osteitis fibrosa cystica (simple or due to hyperparathyroidism), chondroma, single lesions of polyostotic fibrous dysplasia, plasmocytoma or solitary myeloma, certain sarcomata, secondary carcinoma, and tuberculosis. The

characteristic radiographic appearance of these I have described elsewhere (4). My experience is that the typical radiographic picture described above is always associated with the histology of the tumour variously called osteoclastoma, myeloid sarcoma, myeloma, and giant-cell sarcoma. In other words, to the experienced observer the essential histology can be anticipated from the radiographic picture.

2. It weakens the stability of the bone it may fracture the bone, or damage the joint surface, and make amputation appear essential.

3. It removes the scaffolding on which repair can be built up and so delays restitution.

4. It fails to reveal whether or not the tumour will form metastases. Tumours presenting the same histological structure

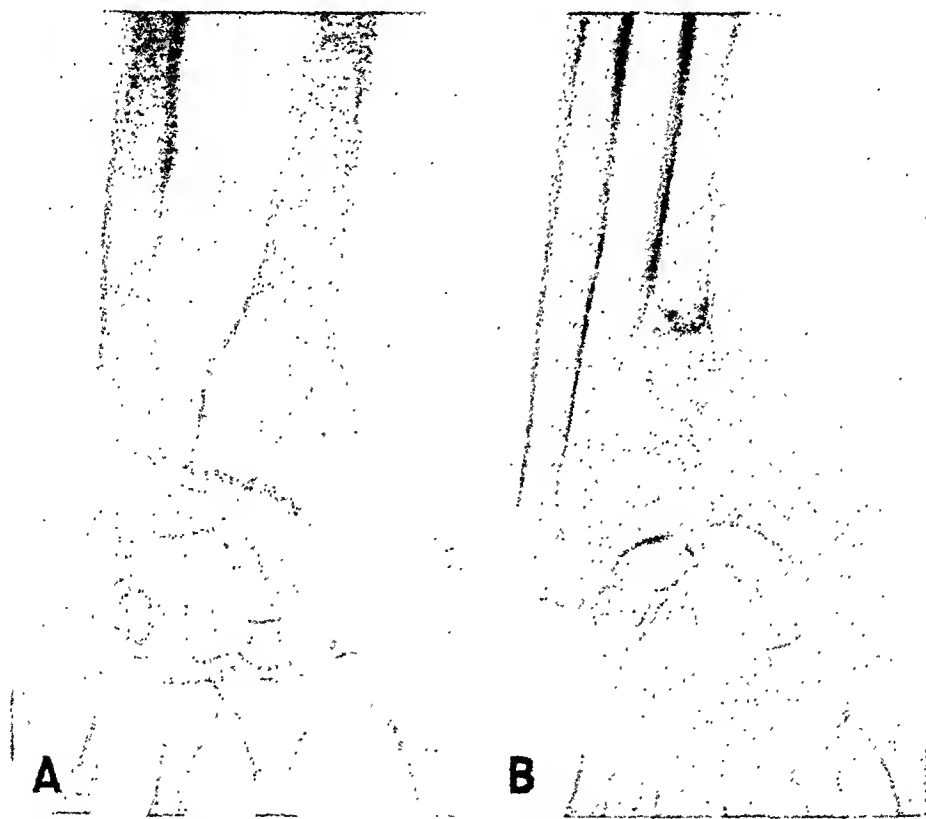


Fig. 2. A. Radiograph showing osteoclastoma at lower end of radius. B. Radiograph of same wrist nine months after curetting.

Faced with the clinical and radiographic evidence of such a tumour in one of the sites mentioned above, the practice being urged today is biopsy of sufficient extent to permit of careful histological examination of all parts of the tumour. Certainly biopsy permits of examination of the histological structure of the tumour but it has important limitations and disadvantages, as follows:

1. It does not reveal any additional features; it merely confirms the radiographic evidence; it may be misleading.

may be eradicated by local curetting or may metastasize and kill the patient.

5. It may actually disseminate the tumour cells.

6. It is an added risk to the patient.

7. There is evidence which suggests that the surgical trauma may incite malignant metaplasia in some cases.

SURGICAL TREATMENT

In those early cases of osteoclastoma in which but a limited section of the bone is involved, localized evacuation of the

tumour cells from the bone followed by carbolization of the walls has been a common procedure. This has been followed by slow consolidation and apparent cure, but I have seen cases in which such a tumour has recurred at the site fifteen to twenty years later and, though amputation was performed, the patient has died from metastases. In some cases in which the local evacuation appeared to be most

ROENTGEN THERAPY

Roentgen therapy first results in an apparent extension of the tumour. Subsequent radiographs, one to three months after irradiation, will show marked increase in the area of osteolysis. Clinically the tumour site becomes much expanded; the skin usually becomes red, glossy, and tight, suggesting increased activity of the tumour. These clinical and radiographic

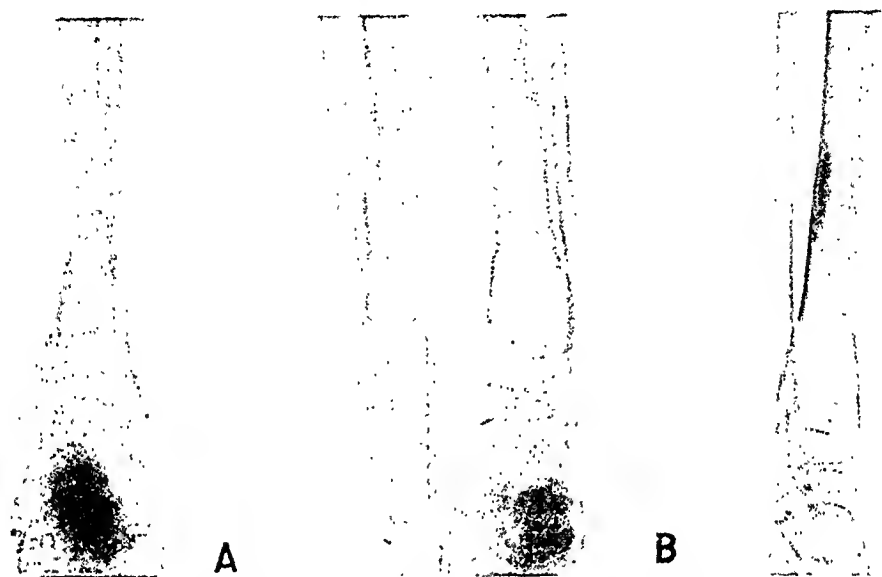


Fig. 3. A. Simple bone cyst in lower end of tibial diaphysis, discovered by radiograph of fracture of shaft. B. Same limb thirty-one months later. Note that the cyst has traveled up the shaft as the result of new bone formation at the metaphysis.

thorough, the tumour has extended so considerably within a few months that amputation has been regarded as essential, but, in spite of this being promptly executed, metastases have developed and death has ensued. Even in the so-called successful case the damage by the surgery seriously impairs the stability of the bone, and fractures or deformities of the joint surfaces are produced, resulting eventually in traumatic arthritis. The removal of so much tissue necessitates a long period of restitution—I have known it to take more than six years for union of fragments to occur. In those cases where the tumour has extensively involved the extremity of a long bone, such as the femur or tibia, amputation has been regarded as the treatment of choice.

features have been regarded as evidence of the activation of tumour cells by radiation and been the cause of many amputations. I was unable to prevent this in a case from which I secured the specimen and had careful histological preparations made. No sign of the typical tumour cells could then be detected; instead degenerate tissue which defined correct interpretation was present. If patience is shown and the case watched for a further period of one or two months, the prominent clinical signs will gradually fade and radiographs will show a progressive reossification of the tumour site. Restoration to normal function may be expected in some sites within the period required for the consolidation of a fracture. With a large area of destruction the time will be

correspondingly increased. The added osteolysis resulting from the radiation must be appreciated and the limb must be immobilized until evidence of re-ossification is obtained, as otherwise fracture may result. Even in those cases in which amputation appears to be the only possible way of preventing invalidism, radiation therapy may lead to consolidation and salvation of the limb.

It may be urged that biopsy is essential because the radiograph is not infallible. My answer is that its infallibility is largely a measure of the extent of the knowledge of radiographic appearances, but in any case it does not seriously matter. There is no simple lesion producing this radiographic appearance which will be improved by biopsy and there is no malignant lesion which will not be the better for the radiation, even if amputation later appears to be desirable. Further, histological interpretation is by no means infallible. The tumours found in the bones in hyperparathyroidism have sometimes identical histological characters, but these respond to enucleation of the parathyroid tumour and have radiographic characters which are entirely distinct. Certain tumours,

like that recorded by Matthew Stewart, are throughout white and solid in consistency, quite unlike the prune juice colour of the typical osteoclastoma, have identical histological characters, but cause death by metastases.

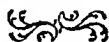
For these reasons I advise that the best treatment for osteoclastoma is roentgen therapy and no biopsy, warning the surgeon to expect the clinical and radiographic evidence of apparent extension of the growth and the possibility of pathological fracture during the first three months.

Illustrations of these lesions are included. Others will be found in previous publications (1-4).

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Lung Abscess Secondary to Stenosing Bronchiogenic Carcinoma¹

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FOR MANY DECADES pulmonary carcinoma has steadily increased in frequency, and the disease is now so common that it is responsible for 10 per cent of all carcinoma deaths (29). At the Charity Hospital of Louisiana it was the cause of more deaths than gastric carcinoma in 1939 and 1940, thereby assuming first place among fatal carcinomas and becoming the most common malignant neoplasm in the male, especially between the ages of forty and sixty-five (16).

In addition to an actual increase in the incidence, there is an apparent increase (4) due in part to "cancer-of-the-lung-mindedness" (27) and to improved roentgenological studies with the aid of penetrating grid films, refined bronchography, and tomography. The all-important bronchoscopic studies with biopsies and the search for an underlying neoplasm in chronic pulmonary and pleural suppurations have also contributed to the greater number of cases, and the knowledge that bronchiogenic carcinoma is a common masquerading (28) and disguising (8) disease is more and more coming to be realized. On the other hand, an actual steady increase is indicated by the observations of competent pathologists and by dependable statistical reports coming from large institutions (34).

As the knowledge of the disease increases, more and more cases are bound to be recognized. Goethe's saying, "what one knows, one sees," is particularly applicable to pulmonary carcinoma (12). Thirty years ago, only 5 per cent of cancers of the lung were correctly diagnosed; now 37 (28) to 50 per cent (1) are recognized

before death. Arkin and Wagner believe that the percentage of correct diagnosis could be raised to 90. Two-thirds could be diagnosed from roentgenograms alone. In the remaining third associated pleural and pulmonary changes may render the roentgen diagnosis difficult or impossible.

Pulmonary carcinoma is still frequently unrecognized for two reasons: (1) When the lung tumor remains practically asymptomatic, metastatic lesions in remote parts of the body may simulate a primary neoplasm. In these instances routine chest films may establish or suggest the correct diagnosis. (2) Stenosing bronchiogenic carcinoma, the most common form, is usually masked by secondary infectious processes of the surrounding lung and pleura. In this type a competent bronchoscopist is usually necessary to detect the growth and obtain a biopsy.

An asymptomatic or silent neoplasm of the lung is easily mistaken as secondary when it is small and its remote metastasis is large. In such cases an erroneous diagnosis of carcinoma of the colon, stomach, liver, or pancreas, or some type of abdominal or mediastinal sarcoma is often made. Intrinsic lesions of the gastro-intestinal tract can easily be excluded by roentgenologic studies, in contrast to doubtful primary tumors of the lymph nodes, liver, and soft tissues with or without destruction of adjacent bone. Metastatic lesions in the adrenals, kidneys, and brain may simulate a primary growth to such an extent that an underlying lung tumor is not thought of during life. Also, cardiovascular disturbances, which are practically always present due to circulatory embarrassment and possibly neoplastic invasion of branches of the pulmonary artery and of the mediastinal organs, are frequently the cause of an incorrect

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diagnosis. The roentgenologic findings of the chest are not always typical of a primary lung cancer. The lesion may be small or large. When it is single rather than multiple, close to the hilum, and in a male, preferably between the ages of forty and sixty-five, a primary carcinoma may be given serious consideration. Unfortunately, the correct diagnosis is of academic interest only, since at present there is no cure in the advanced metastasizing cases.

The stenosing bronchiogenic neoplasm, on the other hand, may be cured if discovered in an early stage. It is now found more frequently than the peribronchial and parenchymal types (6). It grows slowly and tends to form distant metastases only when far advanced. Histologically, it is a squamous-cell growth (2) and shares a relatively benign nature with the mature epidermoids of the skin and adjacent structures, in contrast to the more malignant adenocarcinoma and small-cell carcinoma developing outside of the bronchi (24). Death is usually due to secondary pulmonary changes and postoperative complications and not to the underlying epidermoid (9).

While the parenchymatous and peribronchial tumor may be readily seen on roentgenograms of the chest, the so-called bronchial (4) or endobronchial (20) growth is usually invisible and masked by pulmonary changes secondary to bronchial stenosis. The bronchial stenosis or obstruction may be either incomplete or complete. With incomplete obstruction, the roentgen appearance depends on the presence or absence of a check-valve mechanism. When this mechanism is present, there is localized obstructive emphysema with spreading of ribs and lowering of the hemidiaphragm. Otherwise, there is diminished aeration of a lobe with retraction of ribs, elevation of the hemidiaphragm, and mediastinal shift to the affected side.

When the obstruction becomes complete, atelectasis will develop in a pulmonary segment, lobe, or entire lung, whereby temporary clearing may be mistaken for

resolution in a so-called recurrent or chronic pneumonia. In satellite tumors of the bronchial tree, the obstruction can be complete in one lobe and incomplete in the other, thus causing simultaneously atelectasis of one lobe and obstructive emphysema of the other, as illustrated in the case of Ozlin, Bigger, and Vinson (30).

When the obstruction remains complete, continued secretion on the distal side of the occlusion will cause bronchiectasis (26). Superimposed infection will then become responsible for suppuration, chronic pneumonia, lung abscesses, and pleurisy. As a result of these secondary changes, the tumor may become necrotic to such a degree that it largely disappears and may be recognized only by careful microscopic studies (4).

The knowledge that single or multiple lung abscesses invariably develop (7) distal to a chronically stenosing endobronchial neoplasm is of great importance to the roentgenologist, since, with a prompt diagnosis, radical surgical treatment can be instituted without delay. Otherwise, patients may die from the chronic pulmonary and pleural suppurations, or perhaps from incomplete surgical measures, and not necessarily from the carcinoma.

Unfortunately, the roentgen literature contains but few citations and illustrations of lung abscess distal to a bronchial carcinoma, in contrast to the more frequent discussions in journals devoted to pathology and chest diseases. The following 3 cases which were seen in the City Hospital (New York) within a few days are therefore believed to be of interest.

REPORT OF CASES

CASE 1 (Figs. 1-4): *Squamous-cell carcinoma originating in the right middle lobe bronchus obscured by metastatic pleural tumors and effusion; lung abscess in same location four years previously; chronic cardiac symptoms and clinical impression of carcinoma of sigmoid colon.*

C. P., age 53, white male, laborer, was admitted to City Hospital in October 1942. His complaints were productive cough, dyspnea, night sweats, anorexia, weakness, and muscle pains for two months. One month prior to admission he had a hemoptysis of one teaspoonful of blood. Of special interest

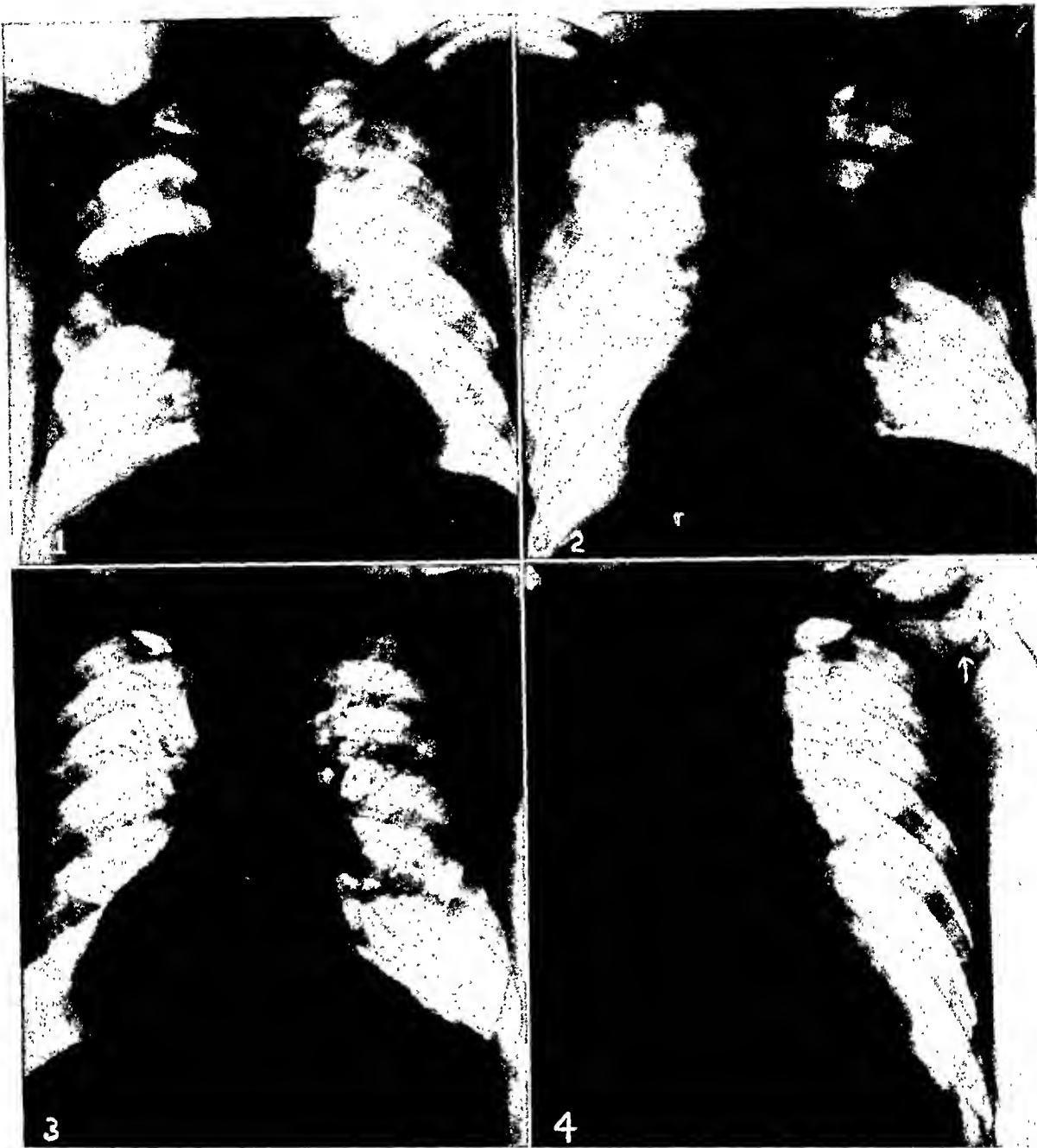


Fig. 1. Case 1: Erect postero-anterior view of the chest in March 1938, showing abscess in right middle lung field with retraction of the right hemithorax.

Fig. 2. Case 1: Supine view of chest made two weeks after Figure 1, showing a more lateral projection of clouding in the right lung above and below the horizontal fissure. A middle lobe involvement is therefore suspected, but no lateral view is available for confirmation.

Fig. 3. Case 1, thirty months later, October 1940. The roentgenogram now shows pulmonary scarring and thickening of the adjacent horizontal fissure in the right middle lung field at the site of the healed lung abscess. Elevation of the right hemidiaphragm with tenting of its dome and again moderate retraction of the right hemithorax suggest diminished aeration and the possibility of underlying bronchostenosis.

Fig. 4. Case 1: Supine view of the chest taken shortly before death, in November 1942, showing marked pleural thickening and effusion in the right chest with obliteration of all details. Osteolytic lesions are seen in the neck of the scapula and in the fifth and ninth left ribs. The clinical impression was primary carcinoma of the colon. Autopsy revealed squamous-cell carcinoma originating in the right middle lobe bronchus with distant metastases.

in this case are the following abstracts of former hospital records:

In 1937, bismuth therapy was given for cerebrospinal syphilis and was followed by signs of toxic hepatitis and dermatitis. X-ray studies of the chest and of the intestinal tract at that time revealed no organic lesion. Early in 1938 a pulmonary consolidation developed in the right middle lung field, which could finally be diagnosed as lung abscess in March 1938 (Figs. 1 and 2). This process became fibrotic two months later, and localized pulmonary scarring was recorded in October 1940 (Fig. 3). The patient was also under medical care for cardiac disorder.

Physical examination at the time of the last admission (October 1942) revealed signs of consolidation in the right lung and a hard movable mass in the left lower abdomen. There was a slight fever, 100° F., and a respiratory rate of 36. The clinical impression was carcinoma of the sigmoid colon and possibly metastatic lesions in the right lung. A chest film taken Nov. 4, 1942, showed an opacity occupying the lower three-fourths of the right lung, fading toward the apex. The underlying lung and hemidiaphragm were completely obliterated. Lack of hyperexpansion of the right hemithorax suggested predominantly pleural thickening and only moderate pleural effusion (Fig. 4). There was no evidence of metastatic lesions in the lungs, but osteolytic processes were observed in the neck of the left scapula and in the fifth and ninth left ribs.

A thoracentesis on the right side produced 350 c.c. of bloody fluid. Soon afterward the patient lapsed into a coma and died on the fourteenth hospital day.

Postmortem examination (Dr. J. R. Lisa) revealed squamous-cell carcinoma originating in the right middle lobe bronchus with extensive suppurative and neoplastic infiltration of the lung. Of special interest were extensive metastatic tumors in the right visceral and parietal pleura, which were so thick as to simulate a primary pleural growth. There were also metastatic tumors in the tracheobronchial lymph nodes, pulmonary artery, right renal vein, adrenals, liver, and skull.

Comment: Squamous-cell carcinoma is known to grow and spread slowly, and the presence of distant metastatic lesions in this case suggests that the growth had existed for a long time. It is reasonable, therefore, to assume that the lung abscess discovered four years prior to death in the same region was the result of a stenosing neoplastic process. Of interest, also, is the tumor invasion of the pulmonary artery, which may partly explain the cardiac disturbance.

CASE 2 (Fig. 5): *Squamous-cell carcinoma of left upper lobe bronchus with abscesses in surrounding lung and marginal empyema simulating cardiac disorder.*

J. P., age 53, white male, elevator operator and formerly a clerk, was admitted to City Hospital with a diagnosis of cerebrospinal syphilis in October 1942. In 1908 he had a chancre, for which he was treated at Bellevue Hospital. In May 1942 he noticed instability of his left leg and went to the Welfare Island Dispensary, where a diagnosis was made of taboparesis with ataxia and Argyll Robertson pupils. He was told there, also, that he had heart disease, for which he was digitalized in June 1942.

After two days on the Dermatological Service of Dr. J. J. Eller, the patient was transferred to the Neurological Service of Dr. J. H. Nolan. There he experienced pain in the left chest, with productive cough and a fever of 103° F. Three weeks after admission, he was referred (Nov. 13, 1942) for x-ray examination, with the tentative diagnosis of left upper lobe pneumonia.

A routine chest film showed an opacity occupying the left upper lobe with an oblique ovoid area of lessened density, 8 × 4 cm., above the hilar region and a similar round area, 2 cm. in diameter, further laterally. The left hemithorax was somewhat expanded in the upper one-half and retracted in the lower one-half. There were also a shift of the heart and mediastinum to the left side and elevation of the left diaphragm, with tenting of its dome. The right lung was normal. A penetrating grid film, taken subsequently, showed a large ovoid cavity and a small round cavity in the left upper lobe. The left upper lobe bronchus appeared dilated, in high position, curved in an upward direction, and seemed to lead into the large cavity. There was also a marginal empyema in the left upper chest (Fig. 5).

Bronchoscopy was advised to rule out an underlying neoplastic lesion of the left stem bronchus. This was done on Dec. 5, 1943. Tumor tissue was found, a specimen was removed for biopsy, and the histological diagnosis (Doctor Lisa) was squamous-cell carcinoma.

The patient had febrile episodes with temperature up to 104° F. for five weeks. His course was downhill and he was transferred to the Medical Service of Dr. W. L. Whittemore on Dec. 18, 1942. Four days later a marked gas distention of the colon developed, for which an exploratory laparotomy was done on the Surgical Service of Dr. L. W. Crossman. Only adhesions were found in the region of the sigmoid colon. Death occurred four days after operation.

Postmortem examination (Doctor Lisa) revealed a bronchiogenic squamous-cell carcinoma of the left upper lobe bronchus, with extension to the mediastinal nodes and cavities in the left upper lobe distal to the growth, which were surrounded by a mar-

ginal encapsulated empyema. There was also intestinal obstruction due to multiple bands of adhesions in the small intestines and the sigmoid colon.

Comment: Cardiac symptoms, which are frequently encountered in bronchiogenic carcinoma, masked the pulmonary neoplasm and the surrounding lung ab-

and ankles for two weeks. He also complained of shortness of breath and jaundice. Previously he was apparently in good health for more than fifteen years.

Physical examination revealed ascites, enlargement of the liver, and masses in the upper abdomen. The blood pressure was recorded as 220/130 mm. and later as 160/100 mm. There was dullness of the



Fig. 5. Case 2: Multiple abscess formations in left upper lobe (arrows) and surrounding empyema. An underlying neoplasm of the left upper lobe bronchus was suspected and confirmed by bronchoscopy and necropsy. This, like Case I, is a case of squamous-cell carcinoma.

scesses. X-ray examination, shortly before death, suggested the proper diagnosis, which was subsequently confirmed.

CASE 3 (Fig. 6): *Squamous-cell carcinoma of the left upper lobe bronchus with abscess of surrounding lung, simulating tumor of stomach and liver with pulmonary metastasis.*

J. D., age 52, white male, coal shoveler, was admitted to City Hospital on Nov. 11, 1942, with a history of weakness, and swelling of the abdomen

left upper chest and fine crackling râles were heard over the same area. The clinical impression was hypertension and primary abdominal disease, possibly carcinoma of the stomach. Cirrhosis of the liver, heart failure, and a metastatic lesion in the lung were also considered.

X-ray studies of the gastro-intestinal tract revealed extrinsic lesions, but no organic disease of the stomach or intestines. A supine view of the chest showed consolidation in the lower parts of the left upper lobe and areas of lessened density in the apex

and first anterior interspace which suggested abscess formations (Fig. 6).

The patient became increasingly confused and icteric. A paracentesis yielded 2,000 c.c. of hemorrhagic ascitic fluid. The temperature rose to 104° F., and death occurred nine days after admission.

Postmortem examination (Doctor Lisa) revealed a bronchiogenic carcinoma of the left upper lobe with a large abscess of the surrounding lung, large metastatic tumors in the liver and hepatic lymph nodes, and an acute bronchopneumonia in the right lower lobe.

Comment: This case, as well as Case 1, shows that metastatic lesions in distal organs are still frequently mistaken for the primary growth, while the pulmonary neoplasm is believed to be metastatic. Since the abdominal masses were not due to an intrinsic gastro-intestinal tumor, the presence of a lung abscess could have suggested a primary bronchial growth. Unfortunately, the patient was seen only in the terminal phase, when he was too ill for proper x-ray studies.

DISCUSSION

The 3 reported cases of pulmonary carcinoma occurred in males at the ages of fifty-two and fifty-three, which compares with the reported average age of fifty-one (2) and fifty-five (28) for lung cancer in males. It is of interest that the disease is found four (19) to ten (35) times more frequently in males and that the average age in females is approximately forty-three. Only Harbitz (17), in Norway, found an almost equal distribution in the two sexes. Statistical data of the City Hospital material since 1920 are now being prepared and will be published later.

In addition to the reported cases, there were a few observations of homogeneous densities distal to hilar carcinoma which could not be recognized as abscesses during life because air and fluid levels were absent. Of interest, also, is a case of terminal bronchiogenic carcinoma seen by the writer in 1941, which was previously diagnosed as abscess. This observation may be likened to Case 1, in which an abscess distal to the carcinoma had healed and did not recur before death.

The differentiation of lung abscess from a carcinomatous cavity is rather difficult at times (31). In both conditions the cavities may be either thick- or thin-walled and solitary or multiple. A rapid increase in size, however, suggests a neoplastic excavation (32, 33), while regressive changes and healing denote an inflammatory condition. Kirklin and Paterson state that "mottling patchiness and lack of centering suggest abscess", while a homogeneous density and definite centering speak for a malignant growth. Tuberculous cavities can be excluded by repeatedly negative sputum tests, and echinococcus cysts differ by showing a smooth wall without infiltration of the surrounding lung and no bronchostenosis.

The roentgen literature contains only a few discussions and illustrations of the masquerading lung abscesses. There is a comprehensive article on the subject by Golden (13) and recently a case in Hauser and Wolpaw's series of "cavitary bronchiogenic carcinoma" (18). In the foreign literature the condition was described by Goldstein (14), Lenk (25), and Bernard and Even (3). Davidson (8) stated in 1930 that abscess may be the first manifestation of a growth which is the real underlying cause of the patient's condition.

Lung abscess develops as a rule secondary to various types of consolidation, to aspiration of foreign material and bronchial obstruction, and less frequently following embolism and spread of suppuration from adjacent structures. The common causes are pneumonia and infarcts (5), anesthesia and operations, especially on tonsils, teeth, jaw bones and neck (11), and such miscellaneous conditions (36) as streptothricosis, actinomycosis, blastomycosis, and infected dermoid and other congenital and acquired cysts. Occasionally, amebic abscess originating in the liver, subphrenic and perirenal abscess, or ulceration of esophageal carcinoma with rupture into the lung is responsible for pulmonary suppuration (15). When all these conditions can be excluded, underlying bronchial carcinoma must be considered, inasmuch as it

causes 10 per cent of all lung abscesses (15, 22). Diagnostic bronchoscopy, therefore, is indicated in all abscess cases with doubtful etiology, especially in males over forty years of age.

Koletsy (24) claims that, in 9 distal abscess cases of a series of 100 autopsies, the growth could have been detected bronchoscopically during life but was missed.

pneumonia in 20 per cent, and purulent bronchitis in 19 per cent.

Bronchial carcinoma with secondary suppuration is usually of the squamous-cell type. This type is more common and less malignant than the peribronchial and parenchymal adenocarcinoma and small-cell carcinoma. The epidermoid or squamous-cell growth progresses slowly and



Fig. 6. Case 3: Supine view of chest shortly before death, showing areas of lessened density in left apex and first anterior interspace suggestive of abscess formations. Underlying squamous-cell carcinoma of the left upper lobe bronchus was found at autopsy. The clinical impression was gastric or hepatic carcinoma and possibly metastatic lesions in the left lung.

Jaffé (21) found lung abscess or gangrene 12 times (12 per cent) distal to the tumor and in 3 cases the clinical diagnosis was lung abscess. In 74 postmortem examinations Arkin and Wagner (1) found abscess or gangrene in 20 per cent; other associated lung changes were pleural effusion in 47 per cent, bronchiectasis in 43 per cent, acute pneumonia in 28 per cent, chronic

spreads beyond the regional nodes infrequently, secondary pulmonary suppurations usually causing death prior to the development of distant metastatic foci (9). Arkin and Wagner reported one case with complete absence of metastatic lesions at autopsy, and Koletsy observed involvement of lymph nodes beyond the regional nodes in only 24 of 36 cases (66 per cent)

and extrathoracic dissemination in only 35 per cent. He believes that the hyparterial bronchus of the left lung is the most favorable location, since tumors here rarely spread beyond the local lymph nodes.

According to the observations of the pathologists, an underlying bronchial neoplasm remains still frequently undiscovered during life when pulmonary suppurations are predominant. It is the writer's impression that a more widespread knowledge of the syndrome among roentgenologists may result in more bronchographic and bronchoscopic investigations and in a higher percentage of correct diagnoses.

SUMMARY AND CONCLUSIONS

1. A steady increase in the incidence of bronchiogenic carcinoma is believed to be due in part to better clinical observations and more refined methods of examination.

2. Pulmonary carcinoma is still frequently unrecognized, for the following reasons: (a) When the lung tumor remains silent, metastatic lesions in remote parts of the body may simulate a primary neoplasm. (b) Stenosing bronchiogenic carcinoma is usually masked by secondary infectious processes of the surrounding lung and pleura.

3. Three cases of secondary lung abscess are reported in which underlying bronchial carcinoma was discovered at autopsy.

4. Stenosing bronchial carcinoma with secondary lung abscess suggests a squamous-cell or epidermoid growth, which is more common and less malignant than other types, but is frequently overlooked, so that patients may die from the secondary suppurations and not from the cancer itself.

5. Lung abscess may still be an early complication of a long lasting malignant disease which, if promptly recognized, may be found to be curable.

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March Fracture, Including Others Than Those of the Foot¹

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WITH THE ADVENT of the Second World War there has been a decided increase in the incidence of march fracture. One may expect to encounter this lesion wherever armed forces are on the march or are undergoing extensive physical training. This is particularly true if the troops are recent recruits and if there is a weight-bearing overload due to heavy packs.

As pointed out by Camp and McCullough (7), march fracture is an example of pseudofracture and may occur in a diseased bone or in a bone subjected to excessive strain. In addition to the metatarsal, the bones involved are likely to be the tibia, femur, pelvis, ribs, radius, and ulna; less frequently these fractures may occur in other parts of the skeletal system.

In so far as the foot is concerned, march fracture may be defined as a painful edematous swelling of the forefoot, insidious in onset and associated with an often unsuspected fracture of a metatarsal. Breithaupt (4), a Prussian military surgeon, first called attention to this entity in 1855. He noticed the painful swelling of the feet in soldiers returning from long marches and considered it an inflammatory reaction in the tendon sheaths due to trauma, a condition which he termed "Fussgeschwulst." Pauzat (23), in 1887, called it *pied forcé* and described it as a severe periosteal proliferation. Stechow (32) first demonstrated the true character of the lesion in 1897 by roentgen studies. It was first noticed in civilians by Deutschländer (9), who reported 6 cases in women in 1921. Swart (34) has recently cited a case of fracture of the second metatarsal

occurring in the seventh month of pregnancy.

ETIOLOGY

Various theories and factors must be given consideration in connection with the etiology of march fractures. An architectural weakness of the foot definitely predisposes to the lesion; flat feet and poor circulation may also be contributing factors (30). The wearing of ill-fitting shoes seems to be an important point. Jansen (14) and Deutschländer (9) stress spasm of the interosseous muscles. Dodd (10), however, considers spasm as secondary and trauma as primary in importance. We believe that a plausible explanation is the excessive degree of muscle strain that takes place. After the muscles are severely exhausted, there is a period of relaxation which permits additional strain on the bones, eventually resulting in fracture. Brandt (3) states that march fracture is based on the torsion mechanics of the foot whereby there is an acute sinking of a previously well formed foot. He has well described the traumatic feature as "rhythmically repeated sub-threshold mechanical insults" to bone rather than a single traumatic incident. Any occupation requiring long-continued walking or standing may lead to march fracture. The majority of cases, however, occur in fresh troops with a high percentage of rookies who have led a more or less sedentary life. As would be expected, the earlier and more detailed reports of the condition came from the highly militarized nations of Continental Europe. German and Swiss troops seemed to be more susceptible because of the "forced or goose step," in contrast to the more relaxed march of other armies. Momburg, quoted by Straus (33), made

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studies of soldiers with no foot complaints and showed by roentgen studies that silent periosteal proliferations of the second and third metatarsals were common. He felt that the fracture was due to prolonged elastic bending of the bone structure.

PATHOLOGY

Few cases have presented opportunity for histologic study. Straus (33) cites a case of metatarsal fracture with a seven weeks' history in which roentgen studies revealed a globular mass about the shaft and no evidence of a fracture line, although the latter was searched for carefully on good diagnostic roentgenograms. The bone was removed on a mistaken diagnosis of malignant bone tumor. Excerpts of the pathologist's report follow: "Examination of the specimen showed a bulbous enlargement 1.6 cm. long and 1.7 cm. wide at the junction of the middle and distal thirds of the shaft. The soft tissues were firmly adherent to this. The surface was rough, with small, quite irregular elevations about 1 mm. in diameter. It was quite hard but could be dented with the fingernail. There was no point of false motion discovered on the first examination of the metatarsal, and it was only after longitudinal section of the bone that the true character of the lesion became evident. There was a narrow dark line of old hemorrhage and granulation tissue crossing the shaft almost transversely at the level of the bulbous enlargement. This stopped at the inner side and did not involve the cortex Microscopic sections through the bone showed it to be well developed and partially calcified osseous tissue"

A similar situation is reported by Dodd (10), in which a radical foot amputation was performed for a suspected neoplasm, which proved, on subsequent pathologic study, to be a march fracture. The importance of bearing in mind march fracture in such instances cannot be overstressed.

CASE STUDIES

This paper is based on 70 cases referred to the Roentgenological Service of Brooke

General Hospital from January 1942 to April 1943, comprising 66 involving the metatarsals, 3 the femur, and 1 the os calcis. The metatarsal cases represent 72 individual fractures, 41 on the right and 31 on the left. As to the specific bone involved, this was the first metatarsal in 1 case, the second in 26 cases, the third in 38, the fourth in 6, and the fifth in 1 case. Multiple fractures in the same foot occurred as follows: Two cases involving the second and third metatarsal and one each the second and fourth, the second and fifth, and the second, third, and fourth.

The proximal portion of the bone was involved in only 6 cases. Forty-eight fractures were located in the mid-shaft and 18 in the distal third. Most of those classified as in the mid-shaft, however, were actually closer to the junction of the middle and distal thirds.

Practically all cases presented varying degrees of periosteal reaction, while only 31 showed definite fracture lines. The greatest amount of callus appeared from one to two months after the onset of symptoms.

The age of the patients varied from twenty to forty-five years, the average being twenty-two. The time interval from the onset of pain to the date of hospitalization was also variable. Approximately 70 per cent were admitted within the first two weeks, and the remainder from two weeks to four months after the onset. The duration of hospital treatment was seldom longer than one month.

Of the 66 men with metatarsal fractures, only 5 were placed on limited duty. Of the remaining 61, 11 received treatment in the out-patient clinic, consisting chiefly of arch supports, proper fitting of shoes, and return to full duty. The other 50 patients were hospitalized, treatment consisting of the application of a plaster walking boot for an average of three weeks, followed by ten to fourteen days of physiotherapy and proper arch supports. All 50 returned to full duty. There were no discharges from the Army for march foot alone.



Fig. 1. Case 1: Roentgenograms made Feb. 12, 1943, twenty-five days after onset of pain, showing oblique fracture line in distal femoral shaft. Note periosteal reaction at fracture margins.



Fig. 2. Case 2: Anteroposterior roentgenogram made on April 2, 1943, forty-three days after onset of pain. Note oblique fracture through distal femoral shaft, left, with an abundance of well formed callus.

All 3 femoral fractures (2 left and 1 right) involved the distal portion of the shaft, with no displacement. One man returned

to full duty and 2 were placed on limited duty. The patient with an os calcis fracture was likewise placed on limited duty.

In a well seasoned division of troops only 8 cases of march fracture were recorded during eleven months in 1942. In a less seasoned division, the incidence was much higher, 62 cases being diagnosed roentgenographically in a four-month period from December 1942 to April 1943. The average length of previous service for the men involved was only three months. It is to be emphasized that training during this period was intensive and long hikes were frequently made. When the hikes were shortened and a more rational training schedule was instituted, the incidence of of march fracture dropped abruptly.

COMMENT

It is evident that a diagnosis of march fracture may be made with a fair degree of certainty in many cases on the basis of periosteal proliferation, even in the absence of a fracture line. In diagnosing the early cases one must insist on obtain-

ing the best roentgenograms possible, in the oblique as well as the conventional superior-inferior position. Nevertheless, a certain number of fine linear fractures will escape detection.

Perhaps the most important consideration in differential diagnosis is malignant growth. Given a globular bony mass about a bone shaft, a demonstrable fracture line, and a reliable history of marching, a neoplasm should not be feared. On the basis of the bony mass alone, there seems to be no accurate description of the struc-

believe that others will be reported in the near future.

CASE REPORTS

CASE 1: H. E. N., private, age 43, was referred for roentgen study Feb. 12, 1943. He stated that about January 18, while on a five-mile hike with a full pack, he stumbled on a rock but did not fall. Ever since that incident he had experienced an aching pain about the left knee and had been put on light duty.

Physical findings consisted of point bone tenderness in the distal left femur just above the medial and lateral condyles.

Roentgenograms revealed a slightly oblique frac-

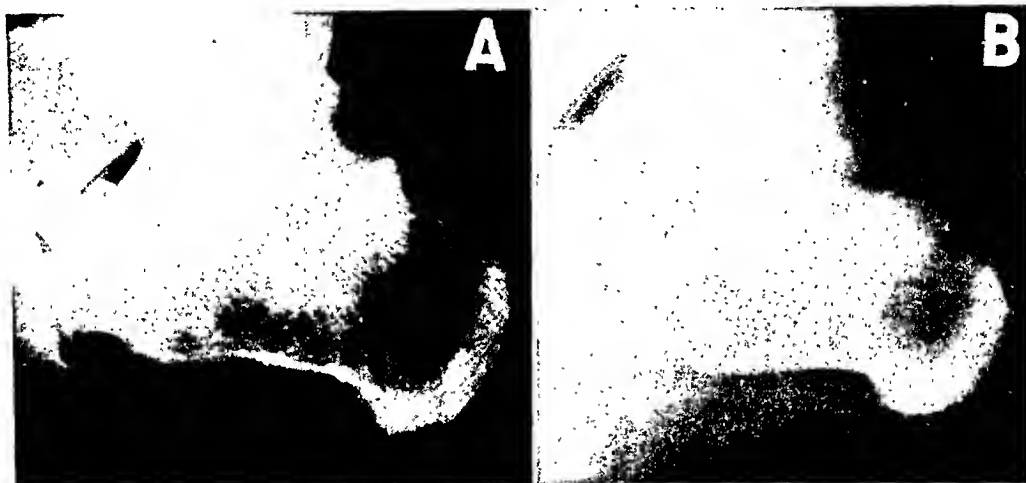


Fig. 3. Case 3: A. Lateral roentgenogram of left calcaneus made on April 9, 1943, showing incomplete fracture, two weeks after onset of symptoms. B. Roentgenogram made on May 17, 1943, fifty-two days after onset. Note callus formation with partial obliteration of fracture line.

tures which will definitely substantiate or rule out a diagnosis of tumor. In selected cases a biopsy may be imperative.

Several reports in recent years show a higher incidence in the second than in the third metatarsal. In our limited number of cases the reverse was true, 26 involving the second and 38 the third metatarsal. Stechow's first report of cases showed a higher percentage in the third than in the second.

Terhune and Eddleman (36), in reporting a case of multiple fracture, state they were unable to find similar cases in the literature. Speed and Blake (31) cite a case of march fracture of the second and third metatarsal but state that it is most unusual. Our series includes five cases of multiple fracture. It is reasonable to

ture through the distal third of the femoral shaft with early callus and no displacement (Fig. 1). Re-examination on March 3 showed no significant change.

Treatment in this case was chiefly physiotherapy, and the patient remained ambulatory. On April 28, 1943, he was assigned to limited duty.

CASE 2: R. S. P., private first class, age 37, was on a practice speed hike of five miles on Feb. 18, 1943, when he suddenly experienced pain around and above the left knee. He fell down and was unable to get up unassisted. Physical examination revealed the presence of normal knee action. Spasm and tenderness of the quadriceps muscle of moderate degree were observed. Although the pain persisted for several days, the patient was not incapacitated and remained on duty.

On March 4 a roentgen study, made because of continued symptoms, demonstrated a slightly oblique fracture of the distal portion of the left femoral shaft.

The patient remained ambulatory with the assistance of crutches and was given a furlough of four weeks. Re-examination on April 2 revealed a fair

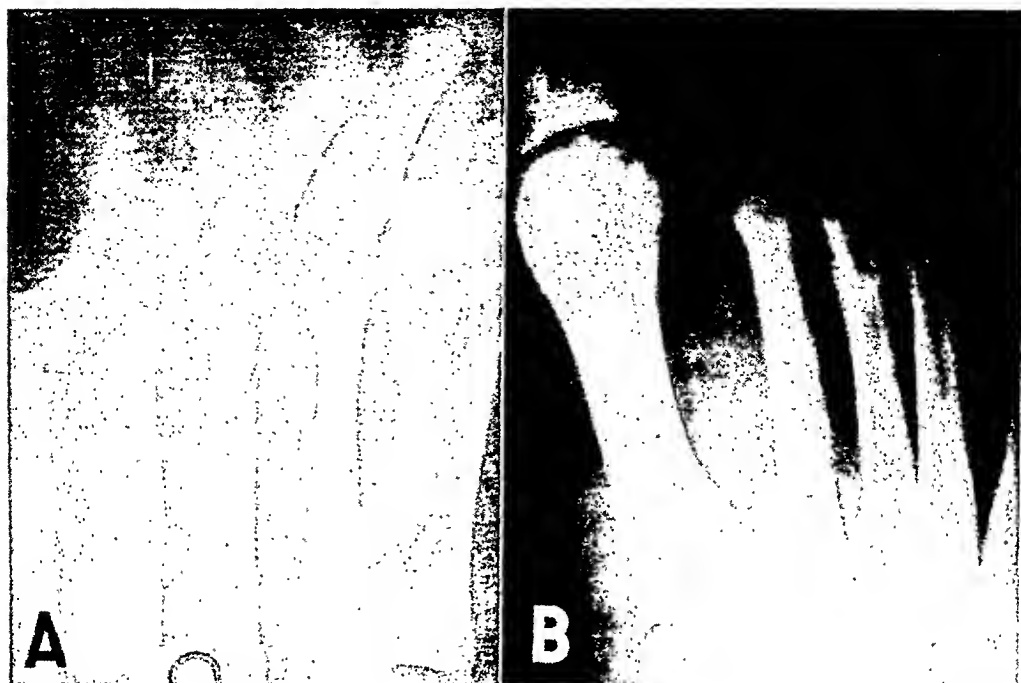
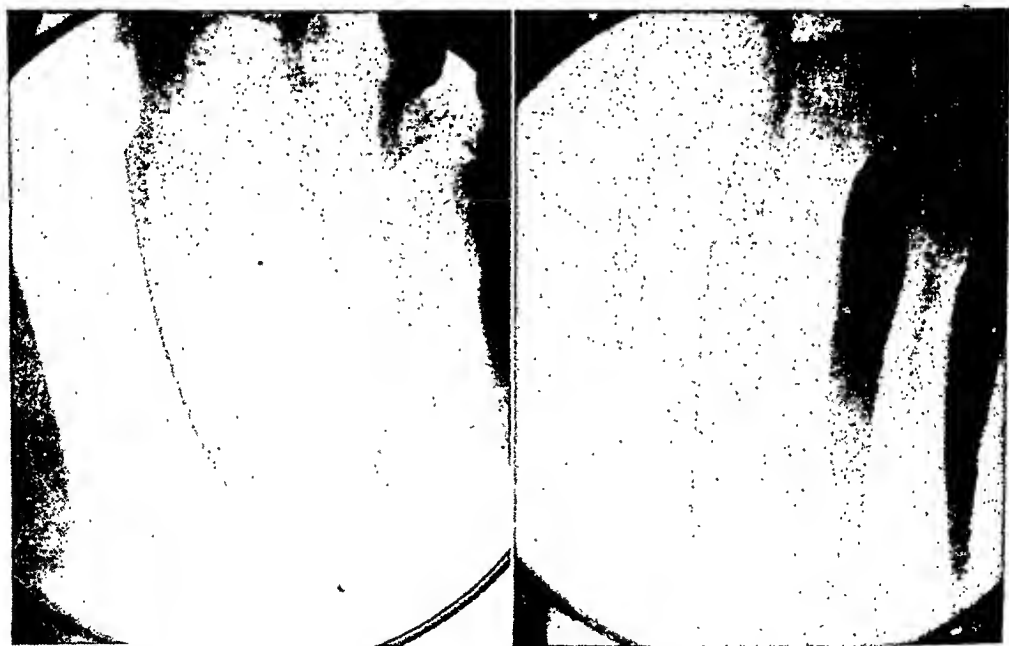


Fig. 4. Case 4: A. Oblique roentgenogram of right forefoot made on Dec. 24, 1942, three days after onset of symptoms. Note complete transverse fracture through distal third of shaft of third metatarsal, without displacement. B. Roentgenogram made on March 2, 1943, ten weeks after onset of symptoms. Note well formed callus about the fracture zone.



Figs. 5 and 6. Cases 5 and 6. Figure 5 (left) is a roentgenogram of right foot (Case 5) made on Feb. 18, 1943, six weeks after onset of symptoms. Note extensive callus formation about fracture in mid-shaft of second metatarsal.

Fig. 6 (right) is a roentgenogram of the left foot (Case 6) made on Jan. 26, 1943, one month after onset of pain. Note extensive periosteal reaction in shaft of third metatarsal.

amount of callus formation about the fracture (Fig. 2). He remained in the hospital receiving physiotherapy and awaiting disposition until May 24, at which time he was assigned to limited duty.

CASE 3: W. J. K., private, age 25, was referred to the Roentgenological Service on April 9, 1943, with a diagnosis of sprain of the left foot. He stated that his left heel began to hurt two weeks previously

and that he had been marching an average of ten miles a day for several weeks. On physical examination there was little evidence of soft-tissue swelling about the heel, although pain was elicited by firm pressure over the bone.

Roentgen study in the lateral and superior-inferior positions revealed an incomplete fracture through the superior portion of the os calcis, slightly posterior to the joint (Fig. 3A). Early callus formation was also observed.

Re-examination on May 17 showed an increase in callus with partial obliteration of the fracture line (Fig. 3B). On June 11 good healing was seen in the roentgenogram, with further obliteration of the fracture line.

A plaster walking boot was applied on April 11 and removed May 18. A sponge rubber arch was given for support. This patient was classified for limited duty on June 2, 1943.

CASE 4: J. E. T., private, age 24, following a five-mile hike on Dec. 21, 1942, noticed a cramping and soreness in the right foot just proximal to the third and fourth toes. The next day he started on a twenty-one-mile hike, whereupon the pain in the foot became more and more severe, forcing him to drop out.

Roentgen study on Dec. 24 revealed a complete transverse fracture through the distal shaft of the third right metatarsal without displacement (Fig. 4A). Moderate localized soft-tissue swelling and tenderness were observed at this time.

On Dec. 28 a plaster walking boot was applied for a period of three weeks. After another three weeks of physiotherapy and arch support the patient returned to full duty. A routine re-examination on March 2, 1943, revealed a moderate amount of well formed callus about the fracture zone (Fig. 4B). At that time the patient was entirely free of symptoms.

CASE 5: F. O. T., private, age 23, was referred to the hospital Feb. 18, 1943, complaining of a gradual onset of pain and swelling in the right forefoot which dated back to a nine-mile hike six weeks earlier. During the interim he had performed his regular duties.

Roentgen study at this time disclosed a fracture through the mid-shaft of the right second metatarsal with associated callus formation (Fig. 5). Swelling and tenderness were confined to the base of this bone.

After routine treatment, consisting in the application of a plaster walking boot, physiotherapy, and arch support, he was returned to full duty on March 16, 1943.

CASE 6: A. L. W., private, age 22, went on a hike of twenty-one miles on Christmas day, 1942. He experienced pain about the ball of the left foot, for which he received physiotherapy. When this gave no relief he was hospitalized, at which time there was moderate tenderness on pressure over the second and third metatarsals, associated with mild soft-tissue swelling.



Fig. 7. Case 7: Roentgenogram of left foot made on Jan. 27, 1943, about two months after onset of pain. Note periosteal reaction in second and third metatarsals.

Roentgen examination on Jan. 26, 1943, showed marked callus formation about the distal portion of the shaft of the third metatarsal (Fig. 6).

Treatment consisted chiefly in further physiotherapy and an arch support. On April 8, 1943, the patient was assigned to limited duty.

CASE 7: E. J. K., private, age 21, had pain and swelling in the ball of the left foot early in November 1942. He reported to the dispensary, where he received treatment for athlete's foot. Although he continued his regular duties, the pain persisted from the date of onset. On Jan. 10, 1943, he experienced a worse attack of pain in the same region. On Jan. 27 the first roentgen study was made, showing an old healed fracture of the mid-shaft of the third metatarsal and what appeared to be a more recent fracture of the second metatarsal near the junction of the middle and distal thirds (Fig. 7). Re-examination on Feb. 15 showed no essential change in either bone. A plaster walking boot was worn from Jan. 28 to Feb. 10. Treatment was by physiotherapy until Feb. 27, 1943, at which time the patient was able to resume full duty.

SUMMARY

1. March fracture, although showing a high incidence in the foot, especially the second and third metatarsals, is occasionally encountered in other parts of the skeletal system.

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2. This condition should be considered an example of pseudofracture, with or without signs of pre-existing disease.

3. The primary etiological factors are believed to be (a) muscular exhaustion, associated with repeated sub-threshold mechanical insults to the osseous system, (b) mechanical insufficiency of an otherwise normal bone, and (c) physiological inadequacy of bone due to a disease process.

4. The all-important factor in diagnosis is to avoid a mistaken interpretation of malignant bone tumor, leading to amputation or other unnecessary radical therapy.

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The Influence of Irradiation of the Ovaries Upon Estrus and Neoplastic Development in Marsh-Buffalo Mice^{1,2}

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EVIDENCE HAS been produced indicating that the Marsh-Buffalo strain of mice is a stumbling block to any attempt to correlate tendency to development of cancer of the mammary gland with the amount of exogenous estrin required to enhance the incidence of this form of cancer in females or to produce it in males (1, 2, 3). Amounts of estrin which enhance formation of breast tumors in other high-cancer strains of mice fail to do so in either males or females of the Marsh-Buffalo strain. The stimulation of endogenous production of estrogens through the gonadotropins has likewise failed to enhance tumor formation of the mammary gland (3, 4). That the tumor is endocrine-linked is, however, well established by the influence of true or of functional castration, and the possibility remains that the production of cancer is the result of an aberration in the hormonal regulation or the production of abnormal hormonal products. In view of the fact that roentgen irradiation of the ovaries, while destroying the follicular mechanism, leaves a residue of interstitial cells capable of liberation of estrogenic substances (not necessarily the same as in the normal mouse) (5, 6, 7, 8, 9, 10), it seemed well worth while to study the effect of such irradiation on the development of breast cancer in the Marsh-Buffalo strain.

EXPERIMENTAL STUDIES

Two groups of 40 mice each of the Marsh-Buffalo strain were segregated for irradiation of the ovaries; equal numbers of litter mates served as controls. Irradiation was

performed after vaginal canalization was established, the latter process usually occurring the sixth week of life. One group of mice received 200 r, the other group 400 r, measured with back-scattering, all at a H.V.L. of 1.15 mm. Cu. Dosage was controlled by a Victoreen Integron III. The lower dose is the one recommended by Geist *et al.* (11) in their studies on irradiation of the ovaries of mice. These authors shielded the head of the mouse with lead, irradiating the trunk. For the purposes of our experiments, we found it necessary to shield the mammary gland arcs and the greater part of the uterus. This was accomplished by taping the mouse to a lead plate which contained a port exposing the area surrounding the ovaries. Five rectangular openings were cut in a lead plate 1.5 mm. thick. Four of these, 1 × 3 cm. each, were equidistant from a central opening measuring 2.2 × 1.5 cm. The distance of the peripheral ports from the central was 4.5 cm. center to center. The mice were strapped over the four peripheral openings with adhesive tape, and the plate, with the mice beneath, was supported under the tube with the central opening in the center of the beam of radiation. The thimble chamber of the Integron was then placed beneath the central opening. Previous tests with a Victoreen condenser meter placed under the peripheral ports in the same relative position as the mice showed that the quantity of radiation, including back-scattering from the lead, was essentially the same beneath all five ports. It may, therefore, be assumed that each mouse received the dose for which the Integron was set.

Vaginal smears on both the irradiated and control mice were taken at suitable intervals throughout the course of the experiment, the spatula method being used. Smears were taken daily for a six-day

¹ From the Departments of Chemistry and of Radiology and Cancer, Santa Barbara Cottage Hospital Research Institute, Santa Barbara, Calif. Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

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TABLE I: INFLUENCE OF 200 R IRRADIATION OF THE OVARIES ON THE INCIDENCE (PERCENTAGE OF TIME) OF THE PRESENCE OF CORNIFIED EPITHELIAL CELLS IN THE VAGINAL SMEAR

Age of Mice in Months	Per Cent Incidence of Cornified Cells		
	Controls	Irradiated Mice	Irradiated Mice Developing Tumors
1.5	33	8	8
2.0	33	21	24
4.0	..	50	48
6.0	20	36	36
8.0	37	24	20
10.0	25	34	32

None of the controls developed continuous estrus. Five of the irradiated mice developed continuous estrus.

TABLE II: INFLUENCE OF 400 R IRRADIATION OF THE OVARIES ON THE INCIDENCE (PERCENTAGE OF TIME) OF THE PRESENCE OF CORNIFIED EPITHELIAL CELLS IN THE VAGINAL SMEAR

Age of Mice in Months	Per Cent Incidence of Cornified Cells	
	Controls	Irradiated Mice
1.5	40 \pm 1	0
3.5	25 \pm 1	20 \pm 1
5.0	27 \pm 1	15 \pm 1
13.5	33 \pm 6	15 \pm 4

period, and the results of these examinations are given in Tables I and II.

The recording, examination, and analysis of the tumor data followed the routine procedures in use in this laboratory (3).

RESULTS

The incidence of cornified epithelial cells in the vaginal smears of the controls 20 to 40 per cent of the time is normal for the mouse and confirms the data of others. It will be noted that 200 r irradiation reduced this figure markedly and 400 r abolished estrus entirely in the period immediately following irradiation. In the mice which received the higher dose, the extent of estrus established for the controls was never attained throughout a thirteen-month period. The lower dose, however produced an increase in estrus the fourth month, followed by a six-month period in which the mean estrus did not deviate markedly from that of the controls. There were, however, 5 irradiated mice which developed a continuous estrus. This phe-

nomenon was never observed in any of the controls. At the seventeenth month of age in the series which had received 200 r irradiation, 7 of the controls and 7 of the irradiated mice had been removed from the experiment through causes not related to carcinoma formation. These included death due to pneumonia and the development of lymphoid tumors. Since these mice and the age of occurrence of the disturbing phenomena were equally distributed between controls and irradiated mice, they need not be considered in the analysis of the tumor data. The cumulative incidence of development of carcinoma in this series is given in Table III. In one of the controls an adenocarcinoma of the parotid developed. In all other cases the characteristic Marsh-Buffalo adenocarcinoma of the breast was observed. It will be noted that at the fifteenth month of age the cumulative incidence of 62 per cent for the irradiated mice *versus* 39 per cent for the controls reveals a significant difference (2 times the standard deviation of the mean, 2.3 times if the parotid tumor is eliminated).

TABLE III: CUMULATIVE INCIDENCE OF ADENOCARCINOMA IN CONTROL AND IRRADIATED (OVARIAN) MARSH-BUFFALO MICE

Age in Months	Control (39 Mice)	200 r Irradiation (39 Mice)	Control (37 Mice)	400 r Irradiation (39 Mice)
7	3	3	3	0
8	8	3	5	8
9	13	18	8	8
10	20	31	14	10
11	31	38	22	23
12	33	43	32	23
13	39	54	43	33
14	39	59	46	41
15	39	62	49	43
16	41	62	51	45
17	50	65	54	48

In the experiment concerned with the higher irradiation dose, 5 mice in the control and 7 mice in the experimental group were removed from the experiment for causes not related to breast tumor formation. The data in Table III for cumulative incidence of breast tumor formation reveal at no time any significant difference between the controls and irradiated mice.

During the course of the experiment lymphoid tumors developed in none of the controls; 5 of the irradiated mice had lymphoid tumors.

The systemic effect of irradiation may be gauged, at least in part, by the span of life, the causes of death not related to tumor formation, and the body-weight-growth curve. Causes of death not related to tumor formation were actually less in both irradiated series than they were for the control series, though the differences are probably not significant. The body-weight curves follow:

AVERAGE BODY WEIGHT

	5 Mo.	7 Mo.	9 Mo.	12 Mo.
Control.....	25.4	26.0	27.6	29.4 \pm 0.6
X-ray 200 r....	24.0	25.8	26.5	27.4 \pm 0.6
	3 Mo.	5 Mo.	13 Mo.	
Control.....	23.1	25.8	28.7	
X-ray 400 r....	21.9	24.7	27.5	

It will be noted that for both series of irradiated mice the body weight curve lags slightly behind that of the controls. The maximum difference, which is less than 7 per cent, is significant.

DISCUSSION

The striking result of the experiment is the observation that by irradiation of the ovaries (200 r) it was possible to produce what it has not been possible to produce by non-toxic doses of estrins or by ovarian stimulation through gonadotropins, *viz.*, an increase in the incidence of adenocarcinoma of the breast. The experiments with hormone administration cannot be regarded as isolated experiments, since they were performed with graded dosage, in large series of animals, and under a variety of conditions (continuous or intermittent effect).

In Table I is recorded the incidence of estrus for the irradiated mice as compared with the incidence for the controls. The incidence is also calculated for those irradiated mice which did not develop tumors. There is no correlation between extent of estrus and tumor develop-

ment. Moreover, in the experiment in which the mice received 400 r, breast cancer development is not decreased, although estrus is markedly decreased. If estrus is accepted as an objective measure for estrin activity (whether exogenous or endogenous), then it must be concluded that tumor development cannot be correlated with degree of estrin activity in this strain of mice. One is forced to admit the possibility that the irradiated ovary produced an abnormal estrin capable of stimulating carcinogenesis to a greater degree than the stimulation due to the normal ovarian secretion.

It should be noted that while irradiation of the ovaries with 200 r produced a significant increase in incidence of breast tumors, it did not increase the incidence of lymphoid tumors. This is contrary to the experience with estrin dosage, with which lymphoid tumor formation was more readily effected than breast tumor formation. In the experiment with 400 r irradiation, the incidence of lymphoid tumors was increased under conditions in which endogenous estrin formation was decreased. It would therefore appear that the increase in incidence of lymphoid tumors, when it occurs after estrin dosage, is probably a secondary effect and not due to a primary carcinogenic action.

In our experiments the uterus, mammary gland arcs, and head were shielded from irradiation. The adrenals must, however, have received considerable radiation. They cannot be eliminated entirely from consideration in the above discussion.

Attempts to correlate the above experiments with observations made in irradiation of human ovaries are hardly feasible. One should bear in mind, however, that the dose (400 r) which decreased estrus markedly was without influence upon subsequent breast tumor development, indicating that nothing short of complete or lasting functional castration would influence the course of carcinogenesis leading to tumors of the breast; moreover, the stimulating dose (200 r) actually increased carcinogenesis.

SUMMARY

Respective groups of 40 mice each received 200 and 400 r irradiation of the ovaries following the establishment of vaginal canalization. Equal numbers of litter mates served as controls.

Immediately following irradiation, the lower dose reduced estrus markedly, while the higher dose reduced estrus entirely. For the higher dose, the extent of estrus established for the controls was never attained throughout a thirteen-month period. The lower dose produced an increase in estrus the fourth month, followed by a six-month period in which the mean estrus did not deviate markedly from that of the controls.

Two hundred r irradiation of the ovaries increased the incidence of adenocarcinoma of the breast significantly, but did not increase the incidence of lymphoid tumors.

Four hundred r irradiation, while reducing estrus markedly, was without influence upon the cumulative incidence of cancer of the breast, but increased the incidence of lymphoid tumors.

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CASE REPORTS

Esophagocecal Fistula Diagnosed Roentgenologically¹

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The fact that a careful search of the medical literature failed to disclose any analogous case either diagnosed clinically or demonstrated roentgenologically seems to justify the publication of the following report.

B. G., white female, 45 years old; esophageal stricture from swallowing lye; apparently successful attempts to dilate stricture not followed by general improvement, severe malnutrition; flushing of bowels shortly after feeding; lower right quadrant pain; roentgen demonstration of fistulous tract between perforation of esophagus and cecum; death from peritonitis following gastrostomy; postmortem examination.

A 45-year-old housewife was admitted March 4, 1943, on the medical service of the Colorado General Hospital, complaining of loss of weight and strength and inability to retain food. The pre-admission diagnosis was severe malnutrition due to esophageal stricture. In October 1941, the patient had accidentally swallowed lye, vomiting one hour later. The next day she went to her local physician, who sent her to a hospital, where she stayed two weeks. She had since been more or less continuously under the care of a competent otolaryngologist, who had been attempting to dilate the developing stricture of the esophagus. In spite of an apparently successful dilatation, the patient, to the surprise of her doctor, continued to lose weight. This observation prompted him to send her to the Colorado General Hospital for thorough study. Some weeks before admission she began to experience discomfort in the right lower quadrant of the abdomen and pain in the right loin, both of which were aggravated by walking and by the erect posture. She therefore walked with a distinct limp, stooping a little forward and to the right and favoring the right side.

The patient stated that she did not always regurgitate her food, which had been invariably in liquid form, and she was sure that sometimes it went into her stomach. On infrequent occasions, about twenty minutes after the meal had been apparently successfully taken, she would notice a

great activity of the intestinal tract, in her own words "a boiling in her bowels." Within another twenty minutes to half an hour she would have several very loose stools resembling in appearance the liquid meal just consumed.

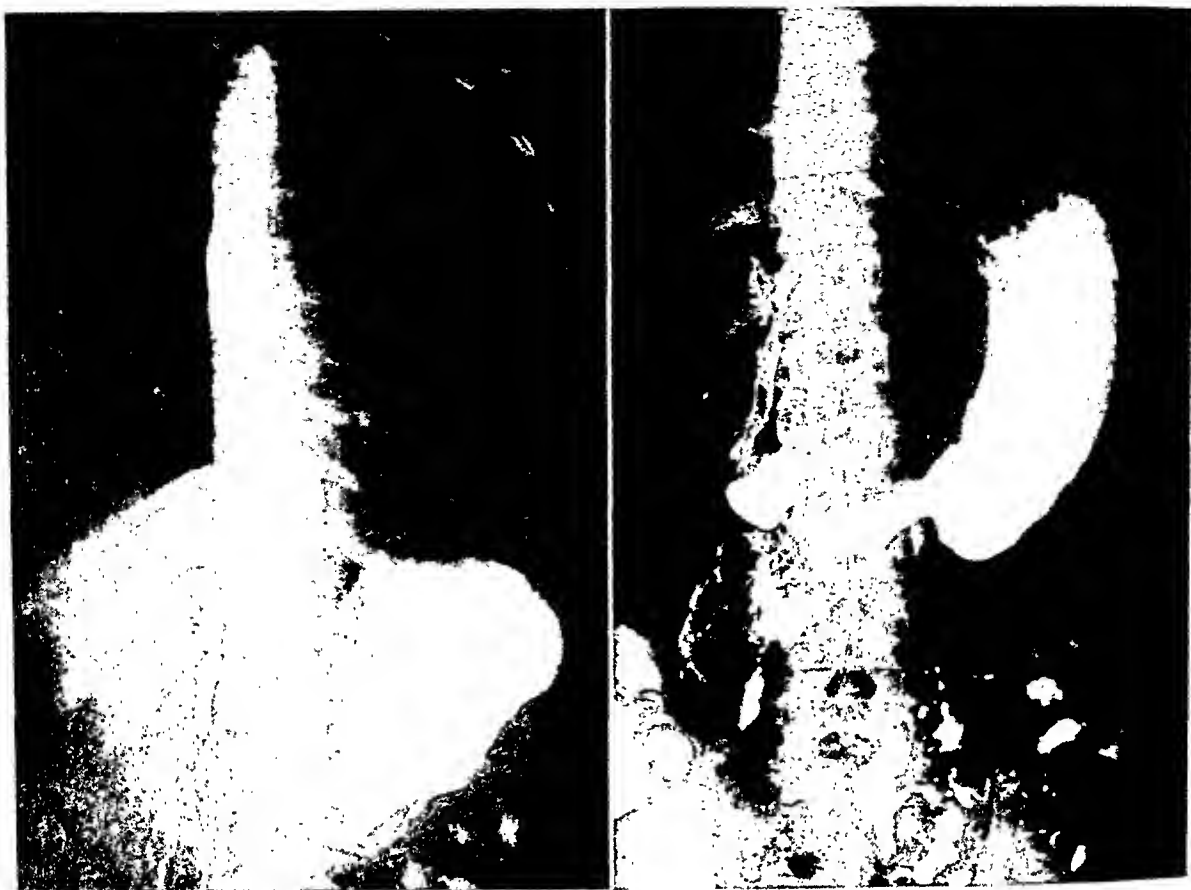
The patient's eyes, ears, mouth, and throat all appeared normal. It is interesting that the usual eye signs and mouth signs of vitamin deficiencies were absent. The tongue was coated, but not smooth, or red, or sore. The lungs were clear (physical examination). The blood pressure was 175/95. The rhythm of the heart was normal and no murmurs were present. The abdominal muscles were rigid, making examination difficult. This rigidity was more marked on the right side, but no obviously tender areas or masses were felt. The spleen and the liver were not palpable; findings on rectal and vaginal examination were normal.

At the time of admission, urinalysis was as follows: specific gravity, 1.020; albumin, trace; no sugar; acetone, 4 plus; otherwise negative. Blood examination on March 2 showed 9.2 gm. hemoglobin; 3,360,000 red cells; 11,000 white cells (polymorphonuclears 67 per cent; lymphocytes 30; endothelial 2; eosinophiles 1). The Wassermann and Eagle tests were negative. An attempt was made to examine the gastric contents. The material aspirated showed no free HCl, but 11 degrees total acidity. The microscopic findings were: pus 4; mucus 2; many gram positive rods suggestive of Boas-Oppler bacilli. Tests for lactic acid and occult blood were negative.

During the first week of hospitalization the patient had a slight elevation of temperature, which ranged between 99 and 101°. During the third and fourth weeks the temperature declined, but her weight, which had gone up to 81 lb., declined to 74 lb.

The first x-ray examination (with the aid of a barium meal) was done on March 11, 1943 (Figs. 1 and 2). It revealed deformity and narrowing of the esophagus at the level of the ninth dorsal vertebra, apparently due to stricture. Part of the barium meal entered the stomach through the lower portion of the esophagus and through the cardia, demonstrating some irregularity of outline and pocket formation in the region of the gastroesophageal junction, probably due to the old injury. A lesser portion of the barium mixture filled a fistulous tract extending from the right of the esophageal stricture in an almost vertical direction through the diaphragm to the right lumbar region, where it subdivided into several branches. There was slight enlargement of upper and middle thirds of the esophagus. No evidence was found of organic lesions in the fundus of the stomach, pylorus, or duodenal bulb. The stomach and duodenum were practically empty after six hours. The gall-

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Figs. 1 and 2. Barium visualization of esophageal stricture, of esophagogastric deformity (apparently old lye injury), and of esophagocecal fistula (with branches).

bladder and appendix were not visualized. There was a slight irregularity in filling of the colon, without definite evidence of an organic lesion. The barium-filled intra-abdominal fistulous tracts appeared practically empty in the 24-hour roentgenogram. There was a ligamentous spondylosis of ankylosing type involving the right aspect of the lumbar spine.

Conclusion: Stricture of esophagus; esophageal deformity at gastro-esophageal junction; fistula of esophagus extending through diaphragm into abdomen; ankylosing spondylosis of lumbar spine.

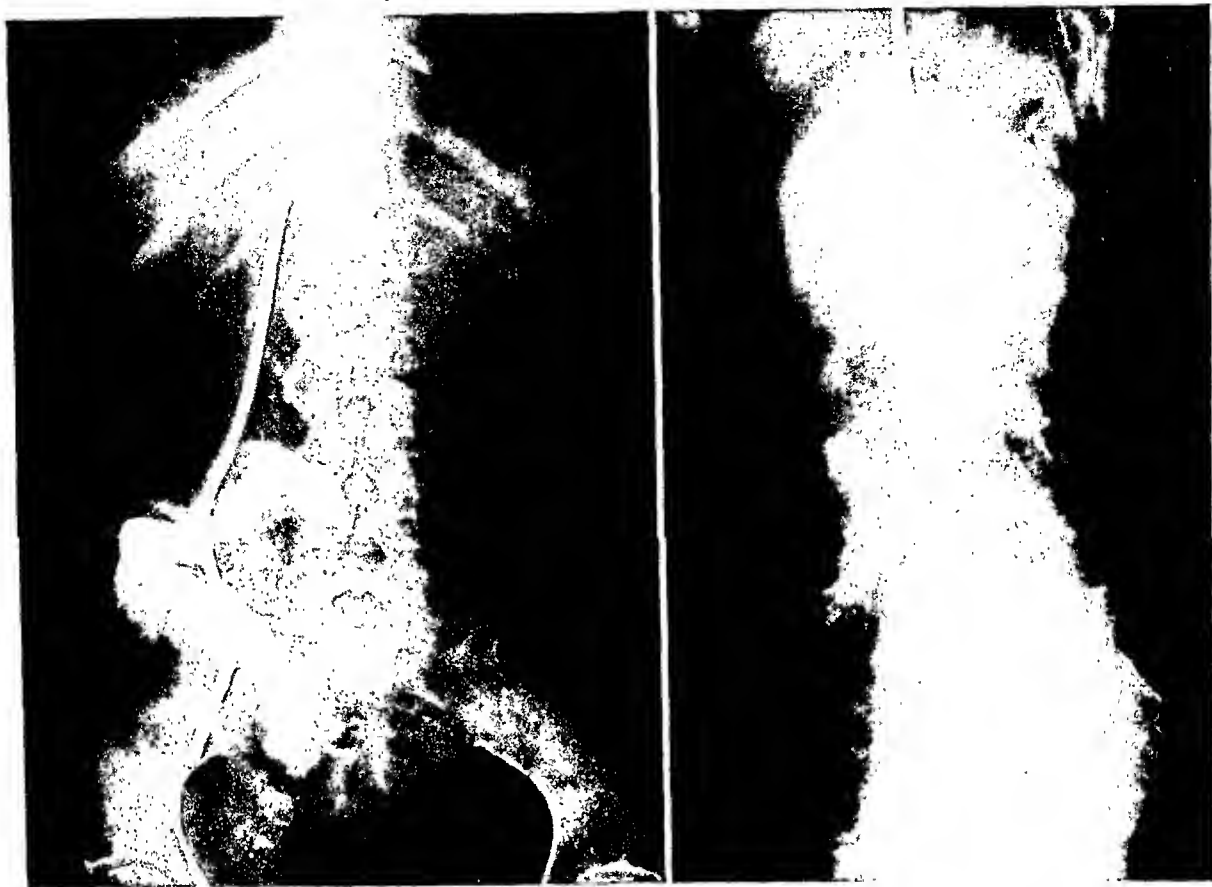
The connection of the esophago-abdominal fistula with the cecum was definitely established by the x-ray examination of April 1, 1943 (Figs. 3 and 4). An esophageal tube was passed through the fistulous tract as far as the cecal region and was injected with a thin barium mixture. This mixture immediately filled the cecum and ascending colon. A subsequent barium enema showed the meeting and merging of the proximal and distal barium columns in the transverse colon. No reflux from the cecum into the fistulous tract was noted in follow-up roentgenograms.

The x-ray examinations of the esophagus and abdomen were unaccompanied by either pain or untoward sequelae.

Roentgenograms of the chest showed prominence of hilar and bronchial markings but revealed no evidence of pathologic changes in heart, lungs, or diaphragm.

On April 7, the patient's 38th hospital day, esophagoscopy was done by Dr. Herman Laff, whose report was as follows: "A moderate amount of undigested food and barium was found in the upper two-thirds of the esophagus. At the opening of the stricture purulent-like material was seen oozing from below. A Jackson bougie was inserted and could be passed beyond the expected region of the cardia, with the conclusion that the bougie was in the retroperitoneal tract rather than in the esophageal lumen. No other opening was seen above the stricture, so that it would appear that the normal lumen of the esophagus branches from the fistulous tract below at the point of the origin of the constriction."

The patient had a moderately severe reaction from this examination, her temperature reaching 102.8° that evening and 104° the next day. She was immediately given sulfathiazole and by the fourth day after the examination the temperature had declined to normal. Sulfathiazole was discontinued ten days after the examination, by which date a total of 45 gm. had been taken. The tem-



Figs. 3 and 4. Barium filling of cecum and ascending colon through esophageal tube (in fistula): anteroposterior and lateral views.

perature remained slightly irregular the last ten days before operation.

During the week following esophagoscopy examination the patient was given intravenous fluids including amino acids, 8 oz. daily. She also had four blood transfusions, each of 250 c.c. citrated blood. Her general condition improved, and it was thought unwise to delay surgery. On April 30, the 61st day of her residence in the hospital, she was operated on by Dr. W. W. Haggart. A large inflammatory mass was found just to the right of the lumbar spine. While this mass extended downward, it did not seem to involve the cecum, as had been suggested in the roentgenograms. It was impossible to feel the bougie which was passed through the esophagoscope and it was deemed inadvisable to perform any type of fistula transplantation on account of the great amount of inflammatory reaction. A gastrostomy was performed and a filiform bougie was inserted from below, through the cardia and into the esophagus, issuing from a very small esophageal opening to the right and anteriorly to the point of the esophageal stricture. The filiform was then grasped through the esophagoscope with a forceps and was brought out through the proximal portion of the esophagus. A string, which had been attached to

the filiform, was then brought out to be attached later to the other end issuing from the gastrostomy stoma. By esophagoscope, two grapefruit seeds were removed from the site of the esophageal stricture. After marsupialization of the stomach at the point of a small opening in the inferior portion, the abdomen was closed. Immediately following the operation the patient received a blood transfusion.

The day after the operation her temperature was 104° and her pulse was 105. Rectal temperatures ranged between 102 and 104° the next two days, after which the temperature declined, but the pulse ranged between 140 and 150. On the seventh post-operative day the rectal temperature began to go up again, ranging between 104 and 106° . The pulse was weak and almost uncountable.

On May 3 it became evident that peritonitis had developed. The abdomen became distended and tender and there was frequent vomiting of small amounts of brownish fluid. A Wangensteen tube was placed in the gastrostomy opening and the patient was given large doses of sulfathiazole by vein and intravenous fluids, with added vitamins and amino acids. Transfusions were also given. Death occurred on May 9, nine days after operation and the 70th day in the hospital.

The autopsy was performed by Doctor Mulligan of the Department of Pathology, seventeen hours postmortem. Of special interest are the findings with regard to the esophagus, the stomach, and the fistulous tract. These are quoted verbatim:

"The esophagus has a roughened, dark green lining and a greatly thickened wall. At a point 6 cm. proximal to the cardia of the stomach, the esophagus is narrowed and puckered to a diameter just admitting a small probe. At this point of narrowing and on the posterior wall is a perforation of the esophagus which enters a sinus tract 25 cm. long that connects with the lumen of the cecum posteromedially. The tract has a shaggy green lining and a thick, gristly, white wall. The tract extends posterolaterally on the right of the esophagus through the posterior margin of the right leaflet of the diaphragm, then posterior to the right adrenal, kidney and cecum and lateral to the bodies of the adjacent lumbar vertebrae. The caudal half of the right kidney and postero-medial part of the cecum are bound together and to the lumbar part of the vertebral column by gristly white tissue, so that sharp dissection is necessary for their removal. The stomach has a serosa irregularly plastered with shaggy yellow material, a thin wall and a dark red mucosa. On the anterior wall of the caudal half of the fundus is a jagged opening 8 cm. in circumference connecting with the recent laparotomy wound. To the right of this opening are two closely adjoining perforations 2 and 2.5 cm. in diameter. On the posterior wall of the stomach, adjacent to the greater curvature and 9 cm. distal to the pylorus, is another perforation 8 mm. in diameter. The three perforations connect with the peritoneal cavity. The small intestine is not remarkable except for irregular plastering of the surface by shaggy yellow material. The appendix is absent. The postero-medial portion of the cecum presents a 2-cm. round perforation which communicates with the caudal end of the sinus tract from the esophagus. In the transverse colon is a 5-mm. sessile mucosal polyp."

SUMMARY

There is presented a roentgenologically diagnosed case of esophageal stricture and esophagocecal fistula following lye burns about one and a half years previously. Due to the lack of any definite history of relevant acute or dramatic episodes, it is impossible to determine when the perforation of the esophagus occurred and whether it was the direct result of the lye injury or of instrumentation. Clinically, three points should be stressed: (1) The patient's history of flushing of the bowels and the appearance of the stools soon after eating was suggestive of an esophageal or

gastric enteric or colic fistula. (2) The pain in the loin with favoring of the right side and splinting of the abdomen suggested ileopsoas spasm. Finally (3), the failure to gain in weight after apparently successful dilatation of the esophageal stricture, in conjunction with the flushing of the bowels and pain in the loin, comprises a highly significant group of symptoms. It is a matter of conjecture whether a rather recent appendectomy had any bearing on the perforation of the fistula into the cecum. The immediate cause of death (peritonitis and bronchopneumonia following gastrostomy and perforations of the stomach) was independent of the reported esophageal and cecal lesions.

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Calcified Spinal Meningioma¹

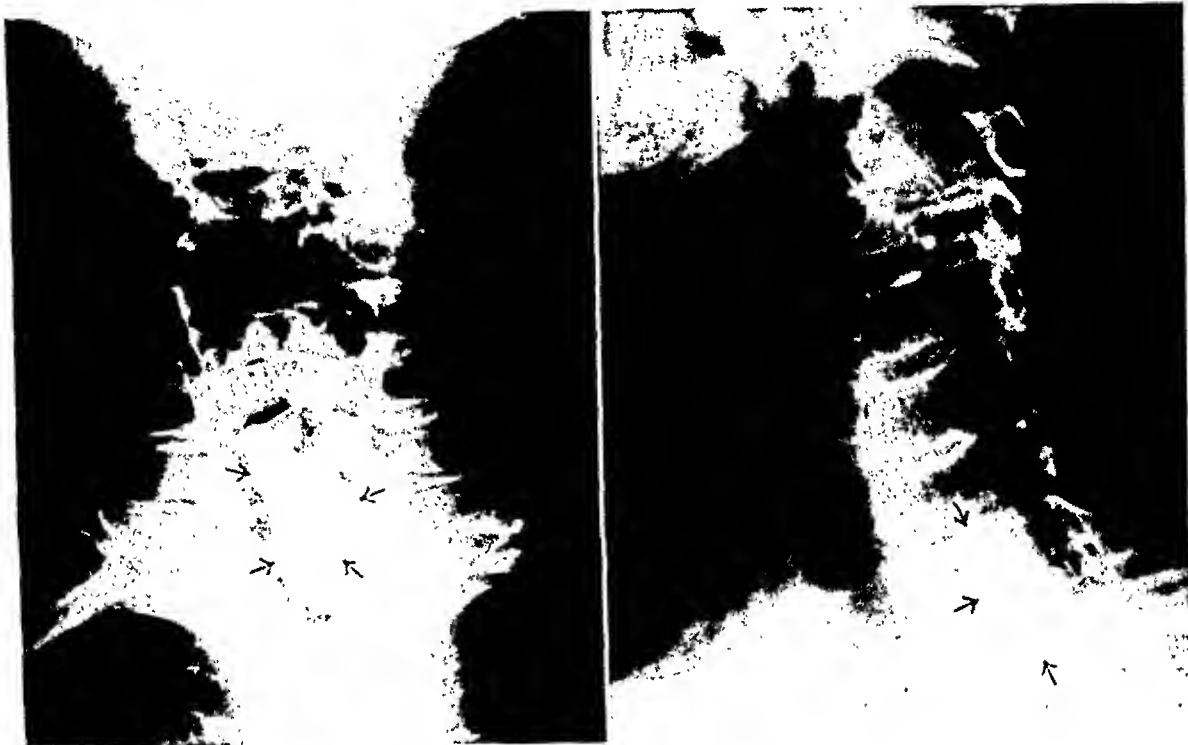
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While meningiomas within the cranium are common, they are seen less frequently within the spinal canal. Still less common is the variety of spinal meningioma which shows sufficiently dense calcification to be visible on the roentgenogram. The opportunity to study such a case prompts the present report.

F. M., an 84-year-old white woman, began to complain of numbness of both hands in June 1939. This symptom progressed gradually and was soon accompanied by pain and weakness. Touch sensation in the hands was diminished but not lost.

A roentgenogram made June 19, 1939, showed considerable diffuse demineralization of the cervical and upper thoracic spine. In the spinal canal, from the level of the lamina of the seventh cervical vertebra to the lamina of the second thoracic vertebra, was a homogeneous, almond-shaped area of calcification which evidently filled the spinal canal almost

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Figs. 1 and 2. Anteroposterior and oblique roentgenograms showing intraspinal calcification.

completely (Figs. 1 and 2). The lamina and the bodies of the vertebrae were intact, and the intervertebral foramina were not enlarged.

A therapeutic trial of x-ray irradiation was decided upon, though without much hope of success. Before this could be completed, cardiovascular complications developed which resulted in death three months later.

Autopsy by Dr. John Hand showed calcification of the mitral and aortic valves, myocardial degeneration, and hypostatic pneumonia. In the seventh cervical and first thoracic segments the spinal cord was found to be partly enveloped by a C-shaped calcium plaque about 4 cm. long and 2 to 5 mm. thick. This tumor was completely calcified and was granular or sandy when cut. Microscopic examination (Dr. Lewy) showed a diffuse mild gliosis in the region of the right pyramidal tracts. There was extensive arteriosclerosis, and hemorrhages were seen in the gray matter on the right side, with destruction of nerve cells but without glial reaction. In the decalcified specimen a fine network of arachnoid cells was seen, embedded in which were numerous concentric calcified psammoma bodies. The microscopic diagnosis was meningioma, psammomatous type, of the spinal cord (Figs. 3 and 4).

Meningiomas of the spinal cord are not uncommon, making up about 25 per cent of all spinal cord tumors (Elsberg, Brown). They are found most frequently in the thoracic cord (78 per cent), less frequently

in the cervical cord (18 per cent) and lumbar and lumbosacral region (4 per cent) (Brown).

Clinically the meningiomas present no specific symptomatology or physical signs. Brown states that "the clinical diagnosis is usually no more specific than that of extramedullary, intraspinal tumor." A preoperative suspicion of meningioma is entertained only in those cases in which there is roentgenographic evidence of intraspinal calcification. Unlike the intracranial meningiomas, the spinal variety seldom, if ever, produces hyperostosis in the adjacent bones (Cushing), and destruction or erosion of bony structures is infrequent.

A number of cases presenting a positive roentgen picture have been reported (Gray). These have been of the psammomatous or osteoblastic type. In the former, laminated calcareous concretions are found, along with irregular deposits of calcium; while in the latter, zones of mature bone formation may be present in addition. These two types of meningioma made up 15 per cent of Brown's series of 130 cases, but in only 4 per cent of these types was

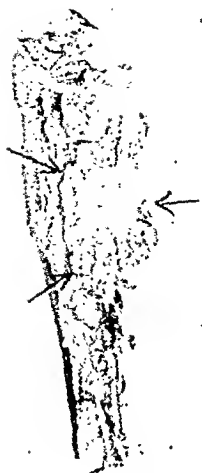


Fig. 3. Calcified spinal meningioma: photograph of gross specimen.

the calcification sufficient to cast a roentgen shadow. Thus it is obvious that only an occasional "rare variant" will be encountered in which there will be an opportunity to make a roentgen diagnosis.

This lesion is usually seen as an almond-shaped mass of calcium lying in the region of the spinal canal, although occasionally the calcification is more granular in appearance, in which case visualization is more difficult. Dyke lists one case in which a diagnosis was made without demonstration of distinct calcification. In this case an unusually dense soft-tissue swelling lateral to the vertebral column was seen, and the increased density of the mass was correctly interpreted as being due to a diffuse calcification; hence the lesion was presumably a meningioma. Calcification is practically never seen in other spinal cord tumors. Tumors of the gliomatous group, which commonly show calcification when situated in the brain, are rarely seen to contain calcium when present in the spinal cord (Elsberg), although Gray has recently reported a case showing calcification in the roentgenogram which was thought at operation to be a vascular oligodendroglioma or an hemangioblastoma. If the calcification is shown in

lateral and oblique views to be entirely within the spinal canal, the probabilities of a meningioma being present are great. In most other lesions in the vicinity in which calcium might be present in visible

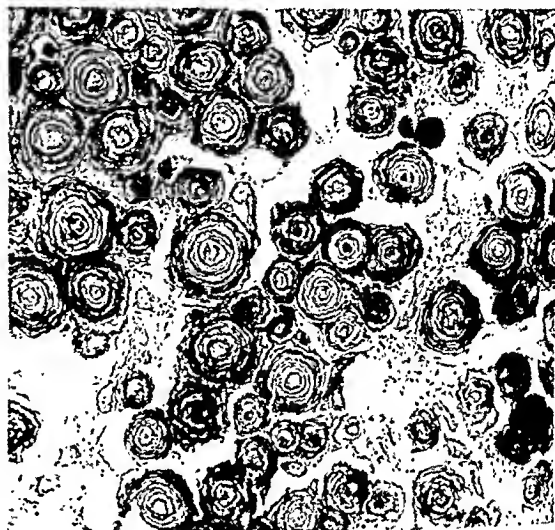


Fig. 4. Photomicrograph of tumor: psammomatous meningioma.

amounts, the changes are not limited to the spinal canal but involve the adjacent structures as well.

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Unusual Stab Wound¹

DANIEL L. MAGUIRE, Jr., M.D.
Resident in Surgery

and

BERNARD S. KALAYJIAN, M.D.
Radiologist

Roper Hospital, Charleston, S. C.

Stab wounds are frequently seen in the emergency rooms of large municipal hospitals. The unique aspect of the case to be reported here was the retention of a major part of the inflicting instrument in the depth of the wound, unknown to the patient or to the physician at the time of the injury.

R. L., a colored male, aged 27, was stabbed in the left side of the face during an altercation with a drunken acquaintance in April 1942. Examination in the emergency room showed only a small laceration, about 1 inch long, in the region of the middle of the left zygoma. Probing failed to reveal any evidence of foreign material, and the lesion was cleansed and sutured; the patient was given a prophylactic dose of tetanus antitoxin and discharged to the clinic for further care. The wound healed by first intention, and the patient was discharged from the clinic five days later, with no complaints, no redness or swelling of the wound, no discharge, no local pain or fever.

On Aug. 26, 1942, about four months after the original injury, the patient returned to the hospital, complaining of pain and stiffness of the jaw. About one month after the stabbing, he began to be troubled with pain in the region of the left zygoma, and he experienced progressive inability to open the mouth completely. The pain in the left side of the face came on insidiously and gradually and never was very acute; it was made worse by opening or closing the jaw. During the last month, a point had been reached where, because of the pain and progressive stiffness, the jaw could be opened only about one inch, and the patient was depending entirely upon liquids for nourishment. He had no other complaints. There was no history of chills, fever, swelling, localized tenderness, or drainage from the site of injury.

The patient was well developed, well nourished, and in no acute distress. The temperature was 98.6°; pulse 84; respirations 22; blood pressure 124/82. The head was normal in size, shape, and contour. There was a small, well healed scar about 1 inch in length just above and parallel to

¹ From the Departments of Surgery, Medical College of the State of South Carolina and the Roper Hospital, Charleston, S. C. Accepted for publication in November 1943.



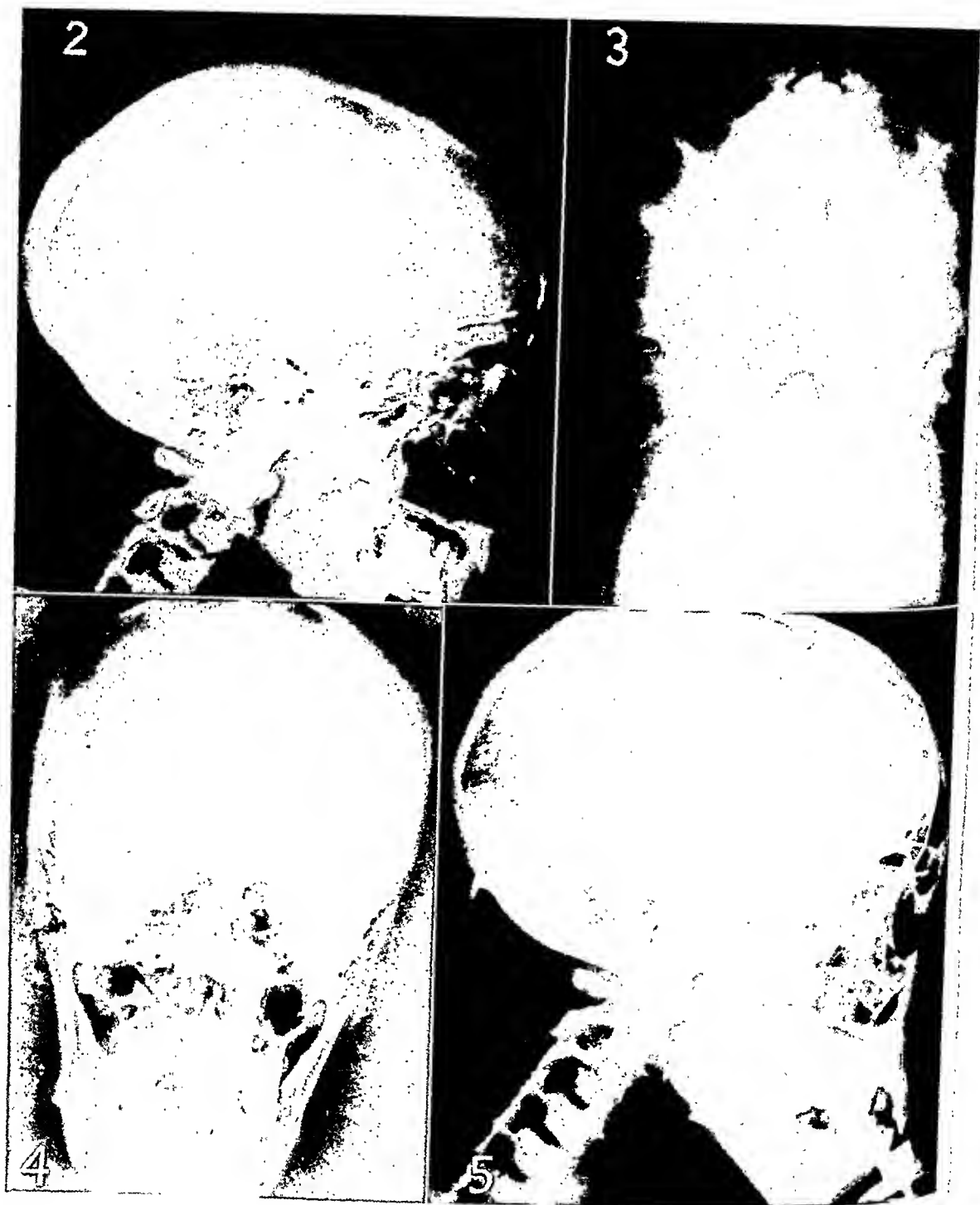
Fig. 1. Knife blade *in situ* (postero-anterior view) and after removal.

the long axis of the left zygomatic arch, midway between the outer canthus of the left eye and the left external auditory meatus. There was no swelling, redness, tenderness, or increased heat in this area. Opening the mouth, either actively or passively, was difficult and painful, and the upper and lower jaw could not be separated more than an inch. Except for this, the physical findings were without significance. The blood and urine were normal and the Wassermann reaction was negative.

Multiple roentgenograms of the skull and jaw revealed the presence of a knife blade, about 2 1/4 inches long and 1/2 inch in width in the soft tissues of the left side of the face. The fragment of blade extended medially, slightly downward and forward from a point just below and medial to the left zygomatic arch (Figs. 1, 2, and 3).

It was apparent that this part of the knife blade had broken off within the wound at the time of the stabbing four months previously, and that it had been buried so deeply that it was not detected at that time. Careful re-examination, with particular attention to the roof of the mouth and the nasal cavity, failed to show any visible or palpable evidence of the blade.

Under sodium pentothal anesthesia a curving incision about 3 inches long was made over the left



Figs. 2-5. Figures 2 and 3 are lateral and submentobregmatic views, showing the knife blade *in situ*. Figures 4 and 5 were made after removal of the blade.

UNUSUAL STAB WOUND

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zygoma and parallel to the arch. With care to avoid branches of the facial nerve, the fibers of the masseter muscle were split and the tissue under the zygoma was explored. Nothing could be found until some of the zygomatic arch was rongeur'd away, when finally, after more searching, dissecting, and palpating, the lateral end of the blade was located. The blade was grasped and extracted with some difficulty but, as it came out, the tiny bent tip (Figs. 1 and 3) broke off and remained deep in the tissues. It was thought unwise and unnecessary to pursue the search for this small fragment, since it was considered unlikely that it would cause any further trouble (Figs. 4 and 5). The wound

was sprinkled with sulfathiazole powder and closed in layers with interrupted silk without drainage. Healing was *per primam*, and no evidence of infection or facial nerve paralysis was noted.

Within a week, the patient was completely relieved of all pain in the side of the face. The pain and stiffness of the jaw gradually passed off, so that about one month postoperatively he was able to open his jaw normally and chew all kinds of food. He was seen one year later, at which time he had no complaints relative to this episode.

Roper Hospital
Charleston, S. C.

EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

The Significance of the Negative Roentgenogram in the Search for Pulmonary Tuberculosis

Reports of cases of pulmonary tuberculosis among the Armed Forces, despite the routine x-ray examination of inductees, naturally raise a question as to the effectiveness of the roentgen method for the discovery of tuberculous lesions. Criticisms of the particular procedure used, as recently voiced by Meyers (1), are not well founded, as can be attested by anyone who has had experience in an induction center. Actually, the relatively few cases subsequently discovered (2) can well be accounted for by factors other than the use of photofluorography. The addition of the skin tuberculin test, as advocated by Meyers, would scarcely contribute anything but delay to the information necessary for determining whether or not an inductee should be accepted. In assessing the various causes for the apparent failure to eliminate all cases of pulmonary tuberculosis by roentgen examination, the matter of the latent period which must exist between the inception of any disease process and its x-ray demonstration should be given consideration.

That there is a delay between the onset of symptoms of disease and the first appearance of roentgen signs is well illustrated in the case of acute osteomyelitis, the time interval here being fairly accurately established. In the case of pneumonia, also, there is fairly good evidence. We have seen one case in which clear-cut roentgen findings were observed within two and a half hours after the first symptoms, but in most instances six hours appears to be the minimum (3). In pulmonary tuberculosis the onset of symptoms is less important, since it is rare that

a tuberculous lesion in the lung capable of producing symptoms is not already clearly demonstrable in the roentgenogram.

There is, however, a latent period between the inception of the tuberculous infection and the appearance of roentgen evidence of a lesion. The tubercles must develop, a number of them must coalesce and an accumulation of abnormal material at least 5 mm. in diameter must ordinarily be present, before x-ray findings are diagnostic. Some years ago, in an attempt to determine the length of this latent period, we studied (4) a small number of cases in which the time of exposure to tuberculosis could be well established and in which repeated x-ray examinations had been made. In this group eleven weeks appeared to be the minimum time between the first exposure and the appearance of a nodule or other shadows less than 1 cm. in diameter. Our subsequent experience had seemed to bear out this observation until recently, when a medical student was encountered who exhibited a nodule 1 cm. in diameter, not previously present, occurring but eight weeks after a clear-cut exposure to tubercle bacilli.

Barnwell (5) has recently reported some cases among nurses, in one of whom an extensive cavitating tuberculosis was seen within fifty-six days after contact. While it is difficult to conceive of tuberculosis advancing so rapidly from the first introduction of the infection, especially in a patient with no preceding pulmonary lesion, yet there are other cases in the literature which substantiate this finding.

In an extremely interesting and instructive monograph by Malmros and Hedvall

of the University of Lund in Sweden, previously reviewed by Dr. A. T. Laird (7), to whom I am indebted for an English translation, some further light is thrown upon this problem. Within a group of 47 carefully studied cases there were 9 in which the time between the first occurrence of a positive skin tuberculin reaction and the appearance of diagnostic x-ray signs could be definitely ascertained. In 7 of these the period ranged from six to eighteen weeks. In the other 2 only ten and twenty-one days elapsed, but in these cases symptoms and a positive sputum were already present, so that the time of the onset of the infection is in doubt.

The determination of the variations in the time required for the development of roentgen signs of pulmonary tuberculosis is a sector of knowledge which is important and has received too little attention. It is evident that four or five months may well elapse between the inception of the disease and its roentgen demonstration. Under such circumstances the negative roentgenogram may have little significance. A certain percentage of the inductees or, for that matter, of any symptomless group being surveyed for tuberculosis, may well escape detection roentgenologically be-

cause the lesion is insufficiently developed to produce roentgen signs. What proportion of the cases now being uncovered fall into this class it is impossible to say. But such considerations do indicate, as suggested by Meyers (1), that re-examination at the end of the first six months in service would be useful in eliminating some men in whom clinical tuberculosis will later develop. Negative findings on the second examination would be of greater significance. Furthermore, this procedure would contribute immeasurably to our knowledge of the development of tuberculosis in young persons.

LEO G. RIGLER, M.D.

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REFRESHER COURSES: POST-GRADUATE INSTRUCTION

A series of Refresher Courses will be presented at the time of the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, at the Palmer House, Chicago, Sept. 24-29, 1944.

These courses of post-graduate instruction will be given from 2 to 5 P.M. and 7 to 9 P.M. on Sunday, Sept. 24, and from 8:30 to 10 A.M. daily thereafter during the meeting. Nothing else will be scheduled for these hours, and the courses have been so arranged that those interested in a particular subject may enroll in a related series.

The courses will be held on the Fourth and Club Floors of the Palmer House. Admission will be by ticket only, and reservations will be made in the order in which applications are received. Those who are not members of either of the two participating societies will be charged a fee of Two

Dollars (\$2.00) for a single course or a maximum charge of Five Dollars (\$5.00) for the series. Members of the Armed Forces, residents and fellows in radiology will be exempt from these charges.

Read the description of the courses, noting particularly the days upon which they are offered; study the Plan of Presentation and select carefully your choice for each day, as the number attending each course will be limited. If the directions listed on the Plan of Presentation and Instructions for Enrollment are observed, errors will be avoided.

If the Refresher Courses are not filled by the time of the meeting, tickets will be available at the registration desk, Sunday, Sept. 24, and thereafter.

It may be necessary to alter or revise some of the courses and to change some of the instructors. We will, however, adhere as closely as possible to the choices made.

Course No. 1: Sunday, 2-5 P.M.

Diseases of the Esophagus, Stomach, and Duodenum: Panel Discussion

Staff of Presbyterian Hospital, University of Illinois
(Rush) College of Medicine, Chicago, Ill.
(By Invitation)

FAY H. SQUIRE, M.D.

Chicago, Ill.
Presiding

JAMES B. EYERLY, M.D., GEORGE J. RUKSTINAT, M.D., JOHN M. DORSEY, M.D., and DANELY P. SLAUGHTER, M.D.

JAMES B. EYERLY, M.D.

1. Medical aspects of diseases of the esophagus, stomach, and duodenum.
 - (a) Physiology.
 - (b) Types of diseases.
 - (c) Treatment.

FAY H. SQUIRE, M.D.

2. Radiologic examination of stomach and duodenum, demonstrating pathologic changes.

GEORGE J. RUKSTINAT, M.D.

3. Pathologic anatomy of esophagus, stomach, and duodenum.

JOHN M. DORSEY, M.D.

4. Surgery of the esophagus.
 - (a) Anatomy.
 - (b) Surgical diseases.
 - (1) Congenital abnormalities.
 - (2) Infections.
 - (3) Tumors.

DANELY P. SLAUGHTER, M.D.

5. Surgery of the stomach and duodenum.
 - (a) Anatomy of stomach and duodenum.
 - (b) Gastric and duodenal ulcer and carcinoma.
 - (c) Congenital obstruction of duodenum.
 - (d) Chronic duodenal ileus.

Course No. 2: Sunday, 2-5 P.M.

Roentgenologic Diagnosis of Neurological Lesions: Panel Discussion

Staff of the University of Illinois College of Medicine

Arranged by the late
ADOLPH HARTUNG, M.D.

T. J. WACHOWSKI, M.D.
Asst. Professor in Radiology
Presiding

ERIC OLDBERG, M.D., Professor of Neurology and Neurological Surgery (by invitation)
PERCIVAL BAILEY, M.D., Professor of Neurology and Neurological Surgery (by invitation)
PAUL C. BUCY, M.D., Professor of Neurology and Neurological Surgery (by invitation)
A. S. J. PETERSEN, M.D., Associate in Radiology

Brief historical review of the roentgenologic methods used in neurologic diagnosis. Technical procedures with and without contrast media. Interpretation of negatives with correlation of clinical and pathological findings. Specific information in response to requests from the audience.

Course No. 3: Sunday 2-5 P.M.

Nuclear Physics: 2-3 P.M.

K. W. STENSTROM, Ph.D.
Minneapolis, Minn.

Discussion will include a simple description of the

newer nuclear physics, including subnuclear particles such as protons, neutrons, positrons, mesotrons, etc., and the apparatus for producing them, as the cyclotron, the electrostatic generator, and the betatron.

Information Please: 3-5 P.M.

U. V. PORTMANN, M.D., Cleveland, Ohio, Moderator
EDITH H. QUIMBY, Sc.D., New York, N. Y.
OTTO GLASSER, Ph.D., Cleveland, Ohio
JAMES L. WEATHERWAX, M.S., Philadelphia, Penna.
ROBERT S. LANDAUER, Ph.D., Highland Park, Ill.

Don't only try to "stump the experts" but send in questions on the Physics of Radiology which have been bothering you these many years. Send questions to Dr. U. V. Portmann, The Cleveland Clinic, Euclid Ave. at 93d Street, Cleveland 6, Ohio.

Course No. 4: Sunday, 7-9 P.M.

Carcinoma of the Breast: Panel Discussion

T. LEUCUTIA, M.D.
Harper Hospital, Detroit, Mich.
Presiding

J. J. MOORE, M.D., Pathologist, Chicago, Ill. (by invitation)
HARRY A. OBERHELMAN, M.D., Professor of Surgery, Loyola University School of Medicine, Chicago (by invitation)
B. H. ORNDOFF, M.D., Professor of Radiology, Loyola University School of Medicine
JANET TOWNE, M.D., Loyola University School of Medicine (by invitation)
Major JAMES C. COOK, M.C., Detroit, Mich. (by invitation)
E. WALTER HALL, M.D., Detroit, Mich. (by invitation)

Dr. Leucutia will briefly introduce the newer aspects of therapy of mammary carcinoma, with special attention to the estrogenic theory. Dr. Moore will discuss the various pathologic aspects. Dr. Oberhelman will present the surgical treatment. Dr. Towne will discuss the question of bilateral oophorectomy as a routine procedure, especially in the young, in all operable cases, and will take up the problem of roentgen as compared to surgical castration. Major Cook will consider colloidal lead therapy in conjunction with roentgen therapy. Dr. Orndoff will discuss the radiologic procedures as practised in the various stages of mammary carcinoma. Dr. Hall will discuss the late sequelae incident to over-irradiation, including pleuropulmonary as well as osseous changes.

Course No. 5: Sunday 7-9 P.M.

Film Reading Session

MERRILL C. SOSMAN, M.D.
Boston, Mass.
Presiding

ROSS GOLDEN, M.D., New York, N. Y.
EUGENE P. PENDERGRASS, M.D., Philadelphia, Penna.

Those attending this course are invited and requested to bring reports and roentgenograms of

interesting or difficult cases for presentation and informal discussion. Only cases in which the diagnosis has been proved or in which the evidence is conclusive should be submitted. Those conducting the conference will depend upon voluntary submission of material by members of the audience.

Course No. 6: Monday, 8:30-10 A.M.

Gallbladder and Pancreas

B. R. KIRKLIN, M.D.
Rochester, Minn.

1. Cholecystography by the oral method, with emphasis on the necessity of meticulous care in administering the dye, in executing the roentgenographic technic, and in interpreting the cholecystographic response. Criteria of distinction between normal and abnormal response will be presented, with illustrative cholecystograms.
2. (a) Disclosure of tumors of the pancreas with the aid of opaque ingesta.
(b) Roentgenographic demonstration of pancreatic calculi.

Course No. 7: Monday, 8:30-10 A.M.

Roentgenological and Pathological Study of the Pneumonias

L. R. SANTE, M.D.
Professor of Radiology, St. Louis University
St. Louis, Missouri

In recent years many causes have been found for pneumonia other than the pneumococcus. Many of these pneumonias have been described as atypical pneumonias of unknown etiology. The etiologic agents for these unusual forms are so multiple and varied that they may cause confusion to the radiologist. To clarify the situation, a comparative study of the roentgen manifestations of the various types of pneumonia with the pathological pictures which they produce has been undertaken.

Course No. 8: Monday, 8:30-10 A.M.

Practical Problems in Dosage Measurement

EDITH H. QUIMBY, Sc.D.
College of Physicians and Surgeons
Columbia University

This discussion will include the measurement of the quantity of x-rays in roentgens; the quality in half-value layer; the significance of air *vs.* back-scatter measurements; percentage depth dose; exit dose; depth dose charts; isodose charts and dosage records.

Course No. 9: Monday, 8:30-10 A.M.

Pelvimetry by Modification of Various Methods

FRED O. COE, M.D.
Professor of Radiology, Georgetown University
Washington, D. C.

A survey film of the abdomen is first taken. This is followed by the conventional anteroposterior film as described by Thoms; a lateral view with the patient standing, using the dots for measurements; and a postero-anterior of the outlet following the method of Chassard and Lapine; a total of four films. The procedure is a modification of that used by Doctor Snow. All methods have been modified from the original description.

Course No. 10: Monday, 8:30-10 A.M.

Diaphragmatic Hiatus Hernia

Hernia of the Stomach through the Esophageal
Hiatus of the Diaphragm

MAX RITVO, M.D.
Boston, Mass.

Diaphragmatic hernia of the hiatus type is a relatively common condition and must always be included among the causes of upper abdominal and chest complaints. This condition has not received from many clinicians and roentgenologists the full attention it merits. The symptomatology is indefinite and variable; hence, clinical diagnosis is usually impossible, and the patient is thought to have gallbladder disease, peptic ulcer, angina, etc. Many patients with hiatus hernia have been operated upon because of these incorrect diagnoses. The x-ray offers an accurate and dependable method of establishing the diagnosis; it demonstrates the size of the hernia and its relationship to adjacent structures. In addition, it is important in determining the question of operability.

In this presentation, the roentgen methods of demonstrating diaphragmatic (hiatus) hernias will be described in detail. The differential diagnosis will be discussed. The signs and symptoms will be outlined, and an attempt made to establish a clinical syndrome which may make a clinical diagnosis possible in many instances. The treatment of hiatus hernia will be outlined.

Lantern slide demonstrations will include hiatus hernias, other types of diaphragmatic hernia, and various lesions which may cause confusion in diagnosis.

Course No. 11: Tuesday, 8:30-10 A.M.

Technic of Diagnosis of Duodenal Lesions by the Mucosal Relief Method

F. E. TEMPLETON, M.D.
Cleveland Clinic
Cleveland, Ohio

The conditions influencing the demonstration of a mucosal surface, the equipment and the technic used in examining the stomach and duodenum are discussed. The factors influencing the demonstration of mucosal surfaces are outlined as follows:

A. Physical Factors.

1. The state of the medium.
2. The condition of the mucosa.
3. The contents of the lumen.
4. The build of the patient.

B. Anatomical Factors.

1. Demonstration of the single surface.
2. Demonstration of superimposed surfaces.
3. Clinical application.
 - (a) Under normal conditions.
 - (b) Under pathological conditions.

C. Physiological Factors.

1. Passive factors.
 - (a) Respiration.
 - (b) Position of the patient.
 - (c) Transmitted pulsation.
 - (d) Pressure.
 - (1) Extrinsic.
 - (2) Intrinsic.
 - (e) Muscular.
 - (1) Tonus.
 - (2) Peristalsis.
2. Active factors.

(a) Autonomic theory of Forssell.

After briefly discussing the filming fluoroscope or "spot" machine, the technic of examination will be discussed in detail as follows:

- A. Preparation of the patient.
- B. The media.
- C. Planning the examination.
- D. Actual roentgenologic examination.
 1. A routine method.
 - (a) Fluoroscopy.
 2. Procedures for special situations.
 - (a) Diaphragmatic hernia, with a brief discussion of the phrenic ampulla.
 - (b) Cascade stomach.
 - (c) Pyloric obstruction
 - (d) High posterior bulb and antrum.
 - (e) Air in the duodenal bulb.
 - (f) Patients too ill to stand.
 - (g) Infants.
 3. Indications for exposing of the films.
 - (a) The "spot" film.
 - (b) The "survey" film.
 4. Application of pressure.

Course No. 12: Tuesday, 8:30-10 A.M.

Diseases of the Lesser Circulation

W. WALTER WASSON, M.D.
Denver, Col.

This course will be an attempt to discuss the dynamics of the lesser circulation, with a detailed presentation of the anatomy and the physiology. Every day the roentgenologist is endeavoring to evaluate in terms of pathology the air contents of the lungs and the dynamics of the chest as a whole, and particularly of the lesser circulation. It is hoped that a few facts may be added to

the present knowledge in regard to the lesser circulation. There will be a brief presentation of the clinical diseases of the lesser circulation.

Course No. 13: Tuesday, 8:30-10 A.M.

Radium Physics

K. E. CORRIGAN, Ph.D.
Detroit, Mich.

This discussion will cover natural radioactive disintegration, the particles emitted by radioactive materials, half life, average life, units, and the uranium disintegration series.

Course No. 14: Tuesday, 8:30-10 A.M.

Roentgen Therapy for Infectious Processes

WALTER C. POPP, M.D.

Section on Therapeutic Radiology, Mayo Clinic
Rochester, Minn.

A short introduction will be given covering the theories upon which the roentgen therapy of infections is based, as well as the experimental work of various investigators, and the action of the rays on infectious processes will be explained. Emphasis will be placed on the selection of technique for both acute and chronic processes. The handling of acute infections with small dosages will be considered in some detail. Statistics will be presented, indicating the experience in the treatment of acute sinusitis at the Mayo Clinic. Methods of treatment of a variety of common infections will be presented as individual entities.

Courses Nos. 15 and 20: Tuesday and Wednesday, 8:30-10 A.M.

Four Rare Diseases: Clinical, Pathological, and Roentgenological Aspects

1. Acute Disseminated Lupus
2. Periarthritis Nodosa
3. Erythema Nodosum
4. Sarcoidosis

MERRILL C. SOSMAN, M.D., HOWARD ARMSTRONG, M.D. (by invitation), and ORVILLE BAILEY, M.D. (by invitation)

Peter Bent Brigham Hospital and the Harvard Medical School
Boston, Mass.

(Course requires two days for completion. Not a repeater.)

These four diseases appear frequently enough in the roentgenologist's office to warrant detailed descriptions of their clinical course, laboratory diagnosis and the pathological findings and, above all, the roentgenographic aspects. One of them (acute disseminated lupus) has responded well to x-ray therapy. Complete summaries of each disease from the above-mentioned aspects will be presented along with illustrative cases and methods of treatment.

Course No. 16: Wednesday, 8:30-10 A.M.

Certain Aspects of Motility Disturbances in the Small Intestine

ROSS GOLDEN, M.D.

Professor of Radiology, College of Physicians and Surgeons, Columbia University
New York, N. Y.

The session on the motility disturbances in the small intestine will include a discussion of the normal anatomy and the basic physiology involved in the three groups of intestinal movements. After a brief consideration of the normal, the disturbed motor function associated with nutritional disorders, liver disease, hypoproteinemia, ileus, and allergy will be discussed. An attempt to explain these disturbed motor phenomena in the terms of basic physiology will be made.

Course No. 17: Wednesday, 8:30-10 A.M.

Diseases of the Mediastinum and Associated Conditions

LESTER W. PAUL, M.D.

Department of Radiology, University of Wisconsin
Madison, Wis.

In this discussion will be included those lesions which produce mass shadows of abnormal character within and adjacent to the mediastinum. The anatomy of the mediastinum and of the tracheobronchial lymph node system will be reviewed, followed by a discussion of the roentgen anatomy of these parts. The roentgen aspects of the diseases affecting the mediastinal and tracheobronchial lymph nodes will be presented in some detail, including acute and chronic non-specific infections, fungous infections, primary tuberculosis, and hyperplastic tuberculous adenitis in adults. In this latter connection the lymph node changes seen in erythema nodosum will be discussed. Also, reference will be made to sarcoid disease and an attempt will be made to correlate these conditions as far as present knowledge permits. The various primary and secondary tumors involving the lymph nodes will be covered, particularly Hodgkin's disease, lymphosarcoma, and metastases from primary tumors elsewhere.

Illustrative cases will be used in which serial roentgenograms show the appearance of the chest before the development of the disease, its course, and in some instances a return to normal. Emphasis will be placed on the recognition of early changes as shown by serial roentgenograms. Other diseases that may produce abnormal shadows in the mediastinum will be discussed, including lesions of the spine, pulmonary artery, aorta, esophagus, acute and chronic mediastinitis, intrathoracic thyroid, enlargement of the thymus, and certain forms of carcinoma of the bronchial tree. Cardiac lesions will not be included except as they must be differentiated from extracardiac abnormalities.

Course No. 18: Wednesday, 8:30-10 A.M.**Electronics in Radiology**

OTTO GLASSER, Ph.D.
Cleveland Clinic
Cleveland, Ohio

This is a new course, being given for the first time. Dr. Glasser will correct the impression being foisted on the American public, of the "newness" of Electronics, which actually is about fifty years old. This promises to be a highly interesting session.

Course No. 19: Wednesday, 8:30-10 A.M.**Biologic Reactions of Tissue to Radiation**

Major MILTON FRIEDMAN, M.C.
Army Medical Center
Washington, D. C.

The development of radiation therapy technics has been predominantly based on the disappearance of the tumor and the cure rate. These indexes are too remote from the immediate event to permit observation and evaluation of a specific technic. Hence the great number of "schools" of treatment.

The application of certain clinical and experimental observations of the immediate response of the tumor are helpful in reducing empiricism in radiation therapy. The mechanisms of the histologic effect of radiation on tumors, the recovery processes, and the lethal tumor dose are three features discussed and correlated.

Histologic examination of biopsy specimens of a tumor under irradiation yields information of fundamental importance concerning the efficiency of treatment technic for a particular case. Radiation destroys tumor cells in several ways. Radiosensitive tumors are affected differently from radio-resistant tumors. Observation of the rate and method of recession of different tumors suggests specific rates of application of radiation for each type of tumor.

Consideration of the recovery process becomes progressively more important with increased understanding of its behavior.

It is necessary to construct the plan of treatment on the basis of the daily and total tumor dose in order to apply intelligently the above principles. This procedure permits intelligent handling of a lesion, reveals the inefficiency of many commonly employed radiation technics, and places the treatment on a substantial basis.

Course No. 21: Thursday, 8:30-10 A.M.**Lesions of the Colon Frequently and Easily Overlooked**

HARRY M. WEBER, M.D.
Mayo Clinic
Rochester, Minn.

Advanced pathologic processes occurring in the large intestine usually produce relatively marked morphologic changes in the part of the intestine

affected, and so are discovered without great difficulty roentgenologically. Certain clinically important lesions, however, never become large, or produce alarming symptoms even when small, or are encountered so early in their development that very obvious morphologic changes have not as yet taken place, and thus are easily overlooked at roentgenologic examination. This discussion will be limited to the roentgenologic diagnosis of small neoplastic lesions of the large intestine and to those roentgenologically recognizable changes which signify the earliest manifestations of certain important non-neoplastic lesions of this division of the alimentary tract.

The conduct of the roentgenologic examination of the large intestine will be reviewed briefly, and advantages and limitations of the various diagnostic procedures currently used in this field will be discussed in considerable detail.

Course No. 22: Thursday, 8:30-10 A.M.**Pulmonary Tuberculosis**

C. C. BIRKELO, M.D.
Radiologist, Herman Kiefer Hospital and Maybury
Sanatorium
Detroit, Mich.

This presentation will consist of a lantern slide demonstration of both common and unusual forms of pulmonary tuberculosis. The primary tuberculous infection as it occurs in the child and young adult will be demonstrated. Reinfection tuberculosis of both the productive and exudative types will be shown, and the commonly accepted methods of treatment will be briefly discussed.

Differential diagnosis will include x-ray demonstration of cases which resemble tuberculosis but have been found to be bronchopneumonia, primary and metastatic tumors of the lungs, bronchiectasis and cystic disease, lung abscess, mitral heart disease, and silicosis. All material presented will consist of proved cases.

Course No. 23: Thursday, 8:30-10 A.M.**Roentgen Differentiation of Abdominal Tumors**

SAMUEL BROWN, M.D.
Cincinnati, Ohio

This course will cover the roentgen diagnosis of extra-gastro-intestinal tumors by an indirect method of approach which consists in the study of the stomach and bowels in their relation to the neighboring organs. It has been found that, in the presence of a tumor arising from any of the adjacent organs, characteristic changes take place in the relation, position, and contour of the hollow viscera according to the position of the body as a whole. With these facts at our disposal, it has been possible to diagnose the presence, location, and origin of many a tumor in the abdomen.

REFRESHER SERIES

Joint Meeting

AMERICAN ROENTGEN RAY SOCIETY

AND

THE RADIOLOGICAL SOCIETY

OF NORTH AMERICA

September 24 to 29, 1944

PALMER HOUSE

CHICAGO, ILLINOIS

FILL OUT THE FOLLOWING

Print or type your name.....

Street Address.....

City.....State.....

Check

Member Radiological Society of North America ☐

Member American Roentgen Ray Society ☐

Non-Member ☐

Tear out and mail to Warren W. Furey, M.D., Chairman, Refresher Course Committee,
7144 Jeffery Avenue, Chicago 49, Illinois.

Fill out, also, the enrollment diagram on the reverse side of this page

REFRESHER SERIES

INSTRUCTIONS FOR ENROLLMENT

Read the accompanying description of the courses and study the plan of presentation. It is important that you register early; the number admitted to each course will be limited by the seating capacity of the room. Reservations will be made in the order of the receipt of request.

Non-members will be charged \$2.00 for each refresher course up to a maximum of \$5.00 for the entire series, payable, at the time of application, to Dr. Donald S. Childs. Non-member fees should accompany the request for reservations.

PLEASE INDICATE YOUR CHOICE

	COURSE NUMBER	LECTURER
SUNDAY 2-5 P.M.		
SUNDAY 7-9 P.M.		
MONDAY 8:30-10 A.M.		
TUESDAY 8:30-10 A.M.		
WEDNESDAY 8:30-10 A.M.		
THURSDAY 8:30-10 A.M.		
FRIDAY 8:30-10 A.M.		

Course No. 24: Thursday, 8:30-10 A.M.**Radiotherapy of Hodgkin's Disease and Lymphosarcoma**

MAURICE LENZ, M.D.
New York, N. Y.

Though primary regression of most clinically appreciable masses of Hodgkin's disease and lymphosarcoma is usually obtained by x-ray therapy, survival beyond three years is observed in only a small proportion of cases. In an effort to analyze the causes of these poor results, the relationship between the clinical characteristics and the technic of x-ray therapy was studied in all patients with Hodgkin's disease and lymphosarcoma treated by x-ray at the Presbyterian Hospital, New York, between 1915 and 1941. The result of this investigation will be discussed informally.

Courses Nos. 25 and 30: Thursday and Friday, 8:30-10 A.M.**Roentgenology of the Urinary Tract**

EUGENE P. PENDERGRASS, M.D., GEORGE W. CHAMBERLIN, M.D., B.S., Sc.D., and P. BOLAND HUGHES, M.D. (by invitation)
University of Pennsylvania
Philadelphia, Penna.

(Course requires two days: the first three items being considered on the first day and the second three on the second day.)

1. Roentgen methods and materials.
 - (a) Evaluation of types of examination.
 - (b) Uses and limitation of roentgen procedures.
 - (c) Dangers of urography.
2. The normal urinary tract.
 - (a) Physiology.
 - (b) Anatomy.
 - (c) Roentgen interpretation.
3. Anomalies and variants.
 - (a) Embryology of some of the common anomalies.
 - (b) Role of anomalies in development of disease.
 - (c) Late results of anomalies
4. Roentgen interpretation of genito-urinary tract disease.
 - (a) Stones.
 - (b) Infections.
 - (c) Tumors.
 - (d) Cysts.
 - (e) Miscellaneous.
5. Value of urography in disease primarily outside of the urinary tract.
 - (a) Aneurysms.
 - (b) Retroperitoneal tumors and infections.
6. Cytoscopy and urethrography.

Course No. 26: Friday, 8:30-10 A.M.**Roentgen Manifestations of Acute Abdominal Disorders**

LEO G. RIGLER, M.D.
Professor of Radiology, University of Minnesota
Minneapolis, Minn.

1. Roentgen technic in acute abdominal disorders.
Special technical procedures are necessary in the handling of patients. Variations from the usual technic in the examination of the abdomen, the difficulties, and special procedures necessary will be detailed.
2. Indications for roentgen examination in the acute abdominal disorders.
The various acute processes in the abdomen in which roentgen examination is of great assistance in establishing either the diagnosis or aiding in determining the extent and nature of the process will be presented.
3. Analysis of the scout film of the abdomen.

- (a) The normal appearance of the roentgenogram of the abdomen without contrast medium.

The soft-tissue shadows, the appearance of the gastro-intestinal tract with and without preparation and under varying conditions will be demonstrated.

- (b) The abnormal roentgenogram without contrast medium.

A discussion of the physiologic and pathologic factors in the production of changes in the abdomen will be undertaken.

An analysis of the various findings which can be obtained with different types of acute abdominal disorders and their differential diagnosis will be presented.

Demonstrations will be given of the x-ray findings in:

- (1) Peritonitis.
- (2) Intra-abdominal abscess.
- (3) Small intestinal obstruction.
- (4) Large intestinal obstruction.

4. Value of x-ray examination in the acute abdominal disorders.

An estimation of the reliability of the various x-ray signs and their contribution toward the practical handling of the patient will be presented.

Course No. 27: Friday, 8:30-10 A.M.**X-ray Findings in Low Back Pain**

HOLLIS E. POTTER, M.D.
Chicago, Ill.

A review of both the more common and the rarer x-ray findings in low back pain which must be considered in the clinical diagnosis, the prognosis, and the treatment. Differentiation between vertebral injury and vertebral disease, congenital or acquired.

Course No. 28: Friday, 8:30-10 A.M.**Gynecography: Pneumoperitoneum and
Hysterosalpingography**

ROBERT A. ARENS, M.D. and IRVING F. STEIN, M.D.
(by invitation)
Michael Reese Hospital
Chicago, Ill.

This presentation will consist of a round-table discussion including the history, armamentarium required, and technic of complete gynecography, including transuterine and transabdominal methods, pneumoperitoneum and hysterosalpingography alone and combined. The radiological procedure, including the exposure, distance, posture, etc., will also be shown. Consideration will be given to the diagnostic value of the method, its therapeutic application in tuberculous peritonitis and salpingitis, and

also the value of transuterine insufflation in sterility. The teaching value of the method for students will be stressed. Lantern demonstration.

Course No. 29: Friday, 8:30-10 A.M.**Carcinoma of the Uterus**

HERBERT E. SCHMITZ, M.D., and JOHN F. SHEEHAN
M.D. (by invitation)
Loyola University School of Medicine
Chicago, Ill.

This course will consider the early diagnosis, planning of treatment, dosage, and the more common complications of carcinoma of the uterus and of the uterine cervix. Pathologic changes induced by radiation in carcinoma of the uterus and in the uterus itself will be presented.

ANNOUNCEMENTS AND BOOK REVIEWS

JOINT MEETING AMERICAN ROENTGEN RAY SOCIETY and RADIOLOGICAL SOCIETY OF NORTH AMERICA

Attention is again called to the joint meeting of the American Roentgen Ray Society and the Radiological Society of North America, to be held in the Palmer House, Chicago, Sept. 24 to 29, 1944.

The usual Annual Refresher Series will be presented. Details of the courses appear elsewhere in this issue.

FLORIDA RADIOLOGICAL SOCIETY

The newly elected officers of the Florida Radiological Society, serving for the coming year, are as follows: President, Walter A. Weed, M.D., of Orlando; Vice-President, John A. Pines, M.D., Orlando; Secretary-Treasurer, Charles M. Gray, M.D., Tampa.

MINNESOTA RADIOLOGICAL SOCIETY

At the annual meeting of the Minnesota Radiological Society, held at Rochester at the time of the meeting of the State Medical Society, the following officers were elected for the ensuing year. President, K. Wilhelm Stenstrom, Ph.D., Vice-President, Russel Wright Morse, M.D., Secretary-Treasurer, A. T. Stenstrom, M.D., all of Minneapolis.

Dr. Ralph Bromer was invited to deliver the annual Carman Lecture. He was also guest of honor and speaker at the annual dinner at the Rochester Country Club.

NORTH CAROLINA RADIOLOGICAL SOCIETY

At the recent annual meeting of the North Carolina Radiological Society, the following officers were elected: President, Walter W. Vaughan, M.D., Durham; Vice-President, Allen Tuggle, M.D., Charlotte; Secretary-Treasurer, Major I. Fleming, M.D., Rocky Mount.

RADIOLOGICAL SOCIETY OF NEW JERSEY

At the annual meeting of the Radiological Society of New Jersey, held in Atlantic City on April 26, 1944, the following officers were elected: President, J. H. Wyatt, M.D., Newark; Vice-President, H. J. Perlberg, M.D., Jersey City; Secretary, H. R. Brindle, M.D., Asbury Park; Treasurer, W. H. Seward, M.D., Orange; Counsellor, W. O. Wuester, M.D., Hillside.

INTERNATIONAL COLLEGE OF SURGEONS

The Ninth Annual Assembly of the International College of Surgeons will be held Oct. 3-5, 1944, at the Benjamin Franklin Hotel, Philadelphia. The program will be devoted to War, Rehabilitation, and Civilian Surgery. Dr. Rudolph Jaeger of Jefferson Medical College is General Chairman of the Committee on Arrangements.

Books Received

Books received are acknowledged under this heading and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

TUBERCULOSIS OF THE EAR, NOSE, AND THROAT: INCLUDING THE LARYNX, THE TRACHEA, AND THE BRONCHI. By MERVIN C. MYERSON, M.D., New York City. A volume of 291 pages, with 89 illustrations. Published by Charles C Thomas, 220 E. Monroe St., Springfield, Ill. Price, \$5.50.

RADIATION AND CLIMATIC THERAPY OF CHRONIC PULMONARY DISEASES, WITH SPECIAL REFERENCE TO NATURAL AND ARTIFICIAL HELIOTHERAPY, X-RAY THERAPY, AND CLIMATIC THERAPY OF CHRONIC PULMONARY DISEASES AND ALL FORMS OF TUBERCULOSIS. Edited by EDGAR MAYER, M.D., F.A.C.P., F.A.C.C.P., Assistant Professor of Clinical Medicine, Cornell University Medical College, New York City; Attending Physician New York and Memorial Hospitals; Special Pulmonary Consultant, New York State Department of Labor; Formerly Member Faculty Trudeau School for Tuberculosis; Director (ex urbe) Northwoods and Will Rogers Tuberculosis Sanatoria, Saranac Lake, New York; Consultant on Tuberculosis to the Government of Cuba; Board Member of the Finlay Institute of the Americas. With the Collaboration of the Following Contributors: Louis Beardslee Baldwin, Irvin I. Balensweig, Alfred Lee Briskman, William Chang, Anthony C. Cipollaro, William W. Coblenz, Lloyd F. Craver, Martin Dworkin, Earl C. Elkins, John N. Hayes, Ira I. Kaplan, H. Haig Kasabach, Eugene Kisch, Frank H. Krusen, Henry Laurens, Maurice Lenz, Horace LoGrasso, Harriet C. McIntosh, Clarence A. Mills, Leroy S. Peters, Homer L. Sampson, Stanley L. Wang. A volume of 393 pages, with 46 illustrations. Published by The Williams and Wilkins Company, Baltimore, 1944. Price \$5.00.



C Bachrach

KARL KORNBLUM, M.D.
1893-1944

IN MEMORIAM

KARL KORNBLOM, M.D.

1893-1944

At dawn on May 16, 1944, death came to Karl Kornblum at the age of 51. Stricken abruptly, without premonition, at the height of his brilliant career, he died, within four days, just five years after his former chief, Henry K. Pancoast. This shocking tragedy leaves a place in radiology that will be difficult to fill.

Doctor Kornblum was born in Evansville, Indiana. He was graduated from the University of Indiana in 1916, and from the University of Pennsylvania Medical School, with honors, in 1919. He served as a member of the Intern Staff of the Hospital of the University of Pennsylvania until 1921. He then went into obstetrics and was Resident in Obstetrics for one year. Following this he was Instructor of Surgery in the School of Medicine of the University of Pennsylvania from 1922 to 1929, and was Chief of the Outpatient Department of Surgery during the years 1923 and 1924.

Doctor Kornblum then went into private practice, but he soon learned he was happier when associated with a teaching institution. He returned to the University of Pennsylvania, where he came under the tutelage of Doctor Pancoast, with whom he was associated until 1933. Doctor Kornblum's early training was invaluable to him, and to those with whom he worked, and it served him well in the specialty in which he finally decided to equip himself.

In 1934 Doctor Kornblum became Assistant Professor of Radiology in the Graduate School of Medicine of the University of Pennsylvania and Director of the Department of Radiology at the Graduate Hospital. He resigned from the Graduate School to accept the post of Professor of Radiology at Jefferson Medical College, which had been vacated by the death of Dr. Willis F. Manges. This chair he held from 1938 to 1942. He returned to the University of Pennsylvania in 1943 as Clinical Professor of Radiology and Associate in the Department of Radiology in the Hospital of the University of Pennsylvania, where he remained until his death.

In 1925 Dr. Kornblum married Miss Mabelle Edwards, who was a most sympathetic and devoted wife and in many ways assisted him in his work. They have two children, Joan, aged 16, and Ann, 14 years.

Doctor Kornblum was loved, respected, and admired by his associates, colleagues, and friends. He was a careful clinical investigator and published many articles on radiologic problems. At the time of his death he was busily engaged in preparing a monograph on the roentgen diagnosis of diseases of

the head and sinuses, which was to have been published as one of the new series of handbooks on diagnosis by the Year Book Publishers. He was President of the Philadelphia Roentgen Ray Society in 1933-1934 and was a member of many other scientific societies, including the Radiological Society of North America.

It can be said of Karl Kornblum that he fully justified the confidence which teachers, colleagues, and friends entrusted to him. Those of us who have worked with him have lost a real friend, one who was a constant source of strength and inspiration.

EUGENE P. PENDERGRASS, M.D.

ROBERT WILLIAMS COOPER, M.D.

1898-1944

Dr. Robert W. Cooper died in Galveston, Texas, on March 13, 1944, after an illness of three months. Dr. Cooper was born in Durant, Miss., in 1898. He was graduated in medicine from the University of Pennsylvania in 1923, following which he entered upon general practice in Alton, Iowa. He then specialized in radiology, spending two and one half years in the Radiological Department of Louisiana State University, followed by a year in New York at the Memorial and Presbyterian Hospitals. He established himself in Shreveport in June 1940 and there practised radiology until his death. He was Radiologist for the Schumpert Sanitarium, the Shreveport Clinic, and the Charity Hospital.

Doctor Cooper was a diplomate of the American Board of Radiology and was a member of the American College of Radiology, the Radiological Society of North America, and the American Medical Association. He was President of the Shreveport Radiological Club.

On Nov. 27, 1926, Doctor Cooper married Mabel Matteson, of Au Claire, Wis. To this union three children were born, Robert Lee, now 16; George, 13; and Lynne, 7.

CLIFFORD P. RUTLEDGE, M.D.

WILLIAM McDOWELL DOUGHTY, M.D.

1881-1944

The Lord saw fit to loan this world William McDowell Doughty from Nov. 4, 1881, to April 18, 1944. During this comparatively short period he was the recipient of many honors, accomplished much, and in payment gave more of himself than he received. He had the faculty of making friends, and to him the making of a friend was a thing accomplished. He was primarily a doctor, secondarily a specialist in radiology. He was considerate



WILLIAM McDOWELL DOUGHTY, M.D.
1881-1944

of his associates, and was at all times able to consider agreeably and weigh an opposing point of view.

The character of Doctor Doughty is best exemplified by two quotations which he jotted down: "The way to climb high is to remain on the level" and "Blessed is the man who, having nothing to say, abstains from giving evidence of that fact in words."

Doctor Doughty was born in Covington, Ky., and was graduated from the Miami Medical College, now the Medical College of the University of Cincinnati, in 1906. He served an eighteen months' internship in the Cincinnati General Hospital and did postgraduate work for one year in Vienna and London.

Among the honors which Doctor Doughty received were the following: President of the American Roentgen Ray Society; Fellow of the American

College of Surgeons; Fellow of the American College of Radiology; President of the staff of The Christ Hospital and Director of Radiology in The Christ Hospital, Cincinnati; President of the Cincinnati Academy of Medicine; Member of the Board of Directors of the University of Cincinnati and Associate Professor of Radiology in that institution; Director of Radiology in the Children's Hospital, Cincinnati. He was a member of the American Medical Association, a member of the Radiological Society of North America, a diplomate of the American Board of Radiology, and a member of the Silicosis Board of Referees of the Industrial Commission of Ohio.

No better epitaph may be written of him than this: "God made him—and smiled!"

E. R. BADER, M.D.



RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please co-operate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse 2, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago 11, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo 2, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Earl R. Miller, M.D., University of California Hospital, San Francisco, Calif.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Meets annually during meeting of California Medical Association.

San Diego Roentgen Society.—Secretary, Henry L. Jaffe, M.D., Naval Hospital, Balboa Park, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Martha Mottram, M.D., Suite 1789, 450 Sutter St., San Francisco. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital, from January to June; at Lane Hall, Stanford University Hospital, July to December.

COLORADO

Denver Radiological Club.—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, Charles M. Gray, 306 Citizens Bldg., Tampa 2.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 7144 Jeffery Ave., Chicago 49. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St., Baltimore 1. Meets third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, A. J. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, E. W. Spinzig, M.D., 2646 Potomac St. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha 2. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—Secretary, Hugh F. Hare, M.D., Lahey Clinic, Boston 15. Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—*Secretary*, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—*Secretary*, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—*Secretary-Treasurer*, Leo Harrington, M.D., 880 Ocean Ave., Brooklyn 26. Meets fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—*Secretary-Treasurer*, Joseph S. Gianfranceschi, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month. October to May, inclusive.

Central New York Roentgen Ray Society.—*Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—*Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—*Secretary*, Ramsay Spillman, M.D., 115 E. 61st St., New York 21, N. Y.

Rochester Roentgen-ray Society.—*Secretary*, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—*Secretary-Treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—*Secretary*, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—*Secretary*, J. E. McCarthy, M.D., 707 Race St., Cincinnati 2. Next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—*Secretary-Treasurer*, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 p.m. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer*, Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—*Secretary-Treasurer*, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

The Philadelphia Roentgen Ray Society.—*Secretary*, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia 4. Meetings held first Thursday of each month at 8:15 p.m., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—*Secretary-Treasurer*, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh 24, Pa. Meetings are held on the second Wednesday of each month at 4:30 p.m., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary*, A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—*Secretary-Treasurer*, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—*Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—*Secretary-Treasurer*, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—*Secretary*, E. Lataué Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

WASHINGTON

Washington State Radiological Society.—*Secretary-Treasurer*, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—*Secretary-Treasurer*, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—*Secretary*, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—*Secretary*, E. A. Pohle, M.D., 1300 University Ave., Madison 6, Wis. Meets every Thursday from 4 to 5 p.m., Room 301, Service Memorial Institute.

CANADA

La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.—*General Secretary*, Origène Dufréne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

An Encephalographic Ratio for Estimating the Size of the Cerebral Ventricles. Further Experience with Serial Observations. William A. Evans, Jr. *Am. J. Dis. Child.* 64: 820-830, November 1942.

In a previous communication (*Arch. Neurol. & Psychiat.* 47: 931, 1942. Abst. in *Radiology* 40: 206, 1943) an encephalographic ratio was proposed for estimating the size of the cerebral ventricles and degree of atrophy of the brain. The ratio was obtained by dividing the transverse diameter of the anterior horns by the maximum internal diameter of the skull. Ratios between 0.25 and 0.30 were thought to represent borderline enlargement and those above 0.30 a pathologic ventricular dilatation. Further studies have been carried out to test the influence of some technical factors and common clinical procedures on the measurements used in the ratio, and serial examinations have been undertaken to determine the effect of varying quantities of air in the ventricles and other factors on the constancy of the ratio in the same subject.

Ideally, the roentgen exposure should be made in the anteroposterior projection in the sagittal plane, with the ray vertical and with the head held with the occiput down, so that a vertical line will pass through the outer canthus of the eye and the external auditory meatus. Moderate degrees of obliquity of the skull, however, in the sagittal and coronal planes were found to produce no significant or constant change in the measurements.

Many subjects show no change in measurements at three and at twenty-four hours after air injection, but in the majority there is a tendency for the ventricles to increase slightly in size in the presence of air. Ventricular dilatation is not reduced by spinal tap or influenced by the intravenous injection of hypertonic solutions. The dilatation is much more pronounced in the presence of an active diffuse cerebral lesion, in which case a rapid and irreversible dilatation of the ventricles may occur.

It is recommended that serial measurements be made for forty-eight or seventy-two hours in pneumoencephalography. If no change in measurements occurs, the presumption is that any diffuse cerebral lesion which may be present is "fixed." If the ventricles enlarge, this is presumptive evidence that the lesion is active and progressive. The rate of enlargement seems to be proportional to the degree of "softening" of the brain.

Nine cases are reported.

Hypertelorism. Alfred B. Berkove. *Arch. Otolaryng.* 38: 587-589, December 1943.

A case of hypertelorism occurring in a soldier is reported. Roentgenograms, showing an enlargement of the lesser wings of the sphenoid bone and increased width between the optic foramina, are reproduced.

Mucocele of the Frontal Sinus. Report of Five Cases in Two of Which at Operation the Mucocele Was Found to Be Empty. W. J. McNally, E. A. Stuart, and A. E. Child. *Arch. Otolaryng.* 38: 574-586, December 1943.

Five cases of mucocele of the frontal sinus are reported. This condition must be differentiated from

cystic dilatation of the lacrimal sac, tumor, and abscess within the orbit, tumor of the frontal bone, epidermoid cyst, meningocele, meningioma, and hydatid cyst of the frontal sinus. Roentgenograms are of great assistance in the diagnosis. A mucocele tends to produce dilatation of the whole or of some portion of the involved frontal sinus, and if it enlarges sufficiently, it may also involve the opposite frontal sinus. The resulting cavity, as a rule, is smooth-walled, with a slightly whitened margin, and is relatively radiotransparent. The bony septa ordinarily present in the frontal sinus are usually obliterated. Thinning and bulging of the bony walls may occur, and defects may be present, especially in the floor.

Mucocele involving the frontal sinus calls for adequate and permanent drainage, which can be obtained only by an external operation. In two of the authors' cases the mucocele was found to be empty at operation. There is, however, no clinical method of determining that such is the case preoperatively.

Roentgenograms are reproduced.

Ectodermal Dysplasia (Anhidrotic Type) with Complete Anodontia. A Serial Roentgenographic Cephalometric Appraisal. Allan G. Brodie and Bernard G. Sarnat. *Am. J. Dis. Child.* 64: 1046-1054, December 1942.

A case of ectodermal dysplasia of the anhidrotic type is presented. The patient was first seen at the age of 1 year and 9 months, with complete anodontia, sparse distribution of lanugo-like hair, absence of eyebrows and eyelashes, a pronounced wrinkling of the skin in the orbital area, a lack of normal prominence of the bridge of the nose, and eversion of the lower lip. Microscopic examination of the skin failed to show the presence of sweat glands, sebaceous glands, or hair follicles.

In order to determine the development of the face and jaws, lateral skull roentgenograms were taken at six-month intervals up to the age of 5 years and 4 months and were compared with those of 20 normal white boys during a corresponding period of growth. Analysis of the roentgenograms showed the patient to be within the lower limits of normal and to be growing at a normal rate. This was further substantiated by anthropometric measurements and by roentgen examination of the carpal bones. The author concludes that complete absence of teeth does not significantly impair development of the face and jaws.

THE CHEST

Annular Shadows of Unusual Type Associated with Acute Pulmonary Infection. L. R. Sante and C. E. Hufford. *Am. J. Roentgenol.* 50: 719-730, December 1943.

In recent years a number of cases have been observed in which annular shadows of unusual character appeared in chest roentgenograms of patients with acute pulmonary infection. Clinically, the disease had its onset with evidences of infection, such as a sore throat, mastoiditis, or arthritis, with a rapidly developing systemic infection associated with chills and high fever and leukocytosis. Blood cultures were positive, showing streptococci, or *Staphylococcus aureus*, or some other type of pyogenic organism. Within a few days

after the onset of acute symptoms, multiple nodules, usually rounded, appeared simultaneously throughout both lung fields. These varied in size from 0.5 to 6.0 cm. in diameter and at first usually appeared solid. Central rarefaction rapidly converted them into annular shadows of unusual variety, having walls 2.0 to 5.0 cm. in thickness. In some the rarefaction was not uniform, but in others complete destruction of the center of the nodule resulted in fluid, which showed as a distinct fluid level. For the most part, however, the centers were filled with air, with little infiltrative reaction in the surrounding lung tissues. In most instances the lesions remain for several days or weeks and then gradually disappear. In one case, the ring-like structures persisted for over a year; in another, some became adherent to the pleura, forming localized areas of empyema which had to be drained by operative procedure. Only one patient died. The postmortem study on this patient suggested that thrombosis of the blood vessels played a part in the development of these annular structures, possibly thrombosis of bronchial arteries.

The lesions do not resemble acute pyogenic abscesses in that their outer margins are rounded and smooth, their walls are of uniform thickness, and they lack the surrounding infiltration common to acute lung abscess. They do not resemble infarcts of ordinary type either in shape or location and differ from ordinary emphysematous pleural blebs in that they apparently originate as solid nodular structures which break down and liquefy. Five case reports with accompanying roentgenograms are included. L. W. PAUL, M.D.

Roentgenographic Aspects of Monaldi's Cavity Aspiration in Pulmonary Tuberculosis. W. R. Oehlisi and Edward Kupka. *Am. J. Roentgenol.* 50: 733-742, December 1943.

Aspiration of a tuberculous cavity by suction through a catheter introduced transthoracically is one of the newer surgical procedures used to bring about obliteration of the cavity. It was originally worked out by Monaldi. The roentgenographic aspects of this procedure are discussed on the basis of a series of cases observed at Olive View Sanatorium (California). Accurate localization of the cavity is essential for the operation. This may be done by Johnson's method of localization (*Am. J. Surg.* 8: 1237, 1930), by roentgenoscopic examination, by body section roentgenography, or by lateral films. At the time of puncture of the cavity the patient is examined roentgenoscopically in the supine position and the cavity again localized in relation to the ribs of the anterior chest wall.

Following the application of negative suction, the most dramatic change as seen in roentgenograms made a few days to a week after puncture is a very rapid decrease in the size of the cavity. This occurred in about half of the 17 cases on which this report is based. This favorable response was seen chiefly in those patients whose cavity had ballooned shortly before puncture. Along with this decrease in size, cavities lost the appearance of being under tension. After the initial decrease, further diminution in most cases was much slower. In the majority of patients there was increase in density around the cavity, most noticeable above and lateral to it, with eventual gradual clearing or absorption except for well defined evidence of thickening of the pleura which had not been present before aspiration.

In order to determine cavity closure, body section roentgenography was found essential. This procedure also was necessary for the determination of the presence and size of the tract between the cavity and anterior chest wall through which the drainage catheter was inserted.

The most prompt results were obtained when the cavities were of the balloon type and the poorest in those cases with considerable caseous involvement in the walls of the cavity. L. W. PAUL, M.D.

The Miniature Camera in Medicine. F. Birkinshaw. *New Zealand M. J.* 42: 253-255, December 1943.

The author discusses the miniature camera and enumerates some of its advantages and disadvantages. He concludes that the 4 X 5-inch film approximates the ideal more nearly than the 35-mm. film. In 1940, 100,000 recruits in the Australian Army had their chests examined, at an average cost of between five and six pence, which covered the cost of all films, miniature and 14 X 17 inch, as well as processing and salaries. In this group 1.04 per cent showed roentgen evidences of tuberculosis; in 0.56 per cent the disease was considered to be active. HENRY K. TAYLOR, M.D.

Contrast Examination in Primary Carcinoma of the Lung. S. Di Rienzo. *Rev. argentino-norteamericana de cien. med.* 1: 430-459, August 1943.

The author classifies the bronchographic images of carcinoma of the lung as lacunar defects, narrowing of the bronchus, and total obstruction. A large number of illustrations, well reproduced, illustrate his paper and a lengthy bibliography is appended.

Obstructive Emphysema and Atelectasis in the Same Lung Resulting from Bronchogenic Carcinoma. Abraham G. Cohen. *J. Thoracic Surg.* 12: 714-718, December 1943.

The literature contains scanty reference to carcinoma of the bronchus causing obstructive emphysema. Atelectasis, however, resulting from a tumor is very common. The author reports a case of carcinoma of the right lung in which, after the introduction of a pneumothorax, the upper and middle lobes collapsed and the lower lobe became emphysematous. This was verified at operation, when the entire lung was removed. Examination of the specimen showed the tumor so situated as to occlude the lumen of the bronchi to the upper and middle lobes but only partially close the bronchus to the lower lobe.

HAROLD O. PETERSON, M.D.

Pulmonary and Intestinal Changes in Strongyloidiasis. J. Edward Berk, Marston T. Woodruff, and Alexander W. Frediani. *Gastroenterology* 1: 1100-1111, December 1943.

Strongyloidiasis is primarily a disease of warm climates; in temperate zones it is encountered only occasionally. The migration of workers from the southern United States to the industrial war centers of the north and east and the return of men who have completed military service in tropical climates will probably bring about a wide dispersal of the disease. In patients infected with *Strongyloides stercoralis* pulmonary changes may occur which mimic tuberculosis and other diseases of the lungs. Confusing intestinal abnormalities may also be encountered.

ABSTRACTS OF CURRENT LITERATURE

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Strongyloides stercoralis is a round worm with both a free-living and a parasitic phase of growth. The free-living phase of development takes place in the soil. The fertilized female discharges partially embryonated ova which mature in a few hours and develop into the first stage or rhabditiform larvac, which feed on organic debris in the soil and grow in turn into free-living adults. Under favorable conditions the free-living phase may continue indefinitely. When conditions become unfavorable, the rhabditiform larvae metamorphose into the second stage or filariform larvae, capable of invading the skin of human beings. Once in the skin many of them penetrate to the small blood vessels, through which they gain entrance into the bloodstream and are then carried to the lungs. Here the larvae break out of the pulmonary capillaries into the alveoli, where they develop through postfilariform and preadolescent stages into adolescent worms. Fertilization of the adolescent females may occur in the bronchi. The majority of the worms pass up the respiratory tree to the epiglottis, are swallowed, and pass through the stomach to the small intestine. If insemination has not already occurred in the bronchi or trachea, it does so in the intestine. The fertilized females burrow into the mucosa, mature, and begin to deposit eggs. The eggs hatch in the tissues and the rhabditiform larvae then work their way into the lumen of the bowel, where they mingle in the intestinal current and are discharged in the stool. In some patients infected with *Strongyloides* internal autoinfection or so-called hyperinfection takes place. If fecal matter containing viable rhabditiform larvae is deposited on the perianal skin and remains for several hours, the larvae may metamorphose *in situ* into infective filariform larvae which then invade the skin. In the presence of constipation the first stage larvae may be retained long enough in the bowel to permit their transformation into second stage forms which are capable of invading the mucosa of the lower bowel.

The migration of the filariform larvae from the capillaries into the pulmonary alveoli is accompanied by hemorrhage of variable degree. At times a patchy pneumonitis with consolidation of various lobules develops, resulting from a combination of the mechanical effects of rupture of the alveolar walls and a cellular reaction to which secondary bacterial invasion may or may not be added. During the early stage of active infection with *Strongyloides*, a polymorphonuclear leukocytosis and eosinophilia are characteristic in the peripheral blood. In addition to the acute response, chronic inflammatory changes may follow the lodgment of adult worms in the bronchial and probably the tracheal epithelium.

The great majority of the parasites enter the duodenum and jejunum, but all levels of the intestine may be invaded. The ova and young larvae in the intestinal wall produce a low-grade inflammation in the mucosa and, in great numbers, may cause an unusual degree of destruction of tissue and a great deal of inflammatory exudate. Mucosal ulcerations not uncommonly occur as a result of necrosis and sloughing.

If strongyloidiasis is as prevalent as recent surveys indicate, then some patients must be suffering from acute and chronic pulmonary disease due to infestation with *Strongyloides stercoralis* which is mistakenly attributed to something else. This possibility should be given consideration whenever transient pulmonary infiltrations for which there is no obvious explanation

are discovered on roentgen examination. When the infiltrations are associated with an eosinophilia, strongyloidiasis ought especially to be borne in mind. Parasitic disease of the nature of strongyloidiasis should be suspected whenever dyspnea, cough, or hemoptysis occurs in a person who also complains of abdominal pain, diarrhea, or other digestive tract difficulties.

Diarrhea and abdominal pain are common features of intestinal strongyloidiasis. It is to be anticipated that x-ray examination of the small intestine would in many cases reveal abnormalities in contour, pattern, and motility. In the chronic stages of the disease, when cellular infiltration is marked and fibroblastic deposition is prominent, the formation of granulomatous tumor-like lesions would appear to be a possibility. The authors, however, were unable to find any x-ray studies of this disease.

Two cases of strongyloidiasis are reported. Both patients had pulmonary symptoms and signs prior to their coming under the authors' observation and tuberculosis had been suspected. While it cannot be definitely stated that the lung changes were corporate parts of the strongyloidiasis, the authors believe this possibility exists. In both instances, also, roentgen examination revealed small intestinal abnormalities which it is plausible to consider as related in some way to the parasitic infestation.

Atypical Pneumonia Complicating Severe Varicella in an Adult. L. E. Rausch, T. J. Grable, and J. H. Musser. New Orleans M. & S. J. 96: 271-275, December 1943.

A physician with varicella complicated by laryngeal spasm showed no abnormal chest findings twenty-four hours after the onset of the disease. Two days later, however, a diffuse bronchopneumonic type of infiltration was demonstrable throughout both lung fields. Clinical improvement followed immediately after the institution of sulfathiazole therapy, and a roentgenogram on the fifth day of the illness showed almost complete resolution of the lesion. In the absence of adequate proof of a specific agent the authors classify this as a case of "atypical" pneumonia in spite of the favorable response to sulfathiazole.

HENRY K. TAYLOR, M.D.

Lead Buttons for Intrapulmonary Localization. Edward F. Skinner. J. Thoracic Surg. 12: 754-757, December 1943.

For aid in the localization of pulmonary abscesses or cavities, two metal buttons made of lead or zinc are cut about 1.0 cm. in diameter and 1.0 mm. in thickness. These have different shapes. The patient is examined with the fluoroscope, and a mark is made on the skin in front and in back over the abscess to be localized. Under procaine anesthesia locally, the metal buttons are sewed to the skin at the marks in such a way that, after stereoscopic roentgenograms are made, the metal markers can be cut off, leaving the sutures tied in the skin. The cavities are then localized with respect to the lead buttons by studying the roentgenograms stereoscopically. The case with which the abscess or cavity can be located by a needle and syringe when guided by the buttons greatly facilitates the surgeon's work. The method has been used successfully in about 25 cases.

HAROLD O. PETERSON, M.D.

Newer Concepts in the Diagnosis of Congenital Heart Disease. Murey L. Sussman, Arthur Grishman, and Morris F. Steinberg. *Am. J. Dis. Child.* 65: 922-936, June 1943.

In the past four years the authors have studied upward of 80 cases of congenital heart disease both clinically and angiocardigraphically. They believe that visualization of the cardiac chambers during life, after the intravenous injection of 70 per cent diodrast, has permitted a more accurate analysis of the cardiac contours and a clearer understanding of the disturbed cardiac physiology than were available previously. While they would not exaggerate the value of roentgen examination, they have used roentgenographic features as a basis of their classification of congenital lesions. They list four main groups.

1. Enlarged pulmonary artery segment of the cardiac contour: The pulmonary artery segment may appear prominent roentgenologically in the following congenital defects: (a) atrial septal defect; (b) patent ductus arteriosus; (c) isolated pulmonary stenosis with dilated pulmonary artery; (d) idiopathic dilatation of the pulmonary artery; (e) Eisenmenger's complex.

2. Normal or small pulmonary artery segment with (A) right ventricular enlargement and with (B) left ventricular enlargement: The congenital lesions which fall into the first of these categories are: (a) isolated pulmonary stenosis with a small pulmonary artery; (b) tetralogy of Fallot; (c) cor biatriatum trilobulare; (d) transposition of the great vessels with small pulmonary artery. The second group includes (a) coarctation of the aorta; (b) atypical coarctation of the aorta with absence of the left radial pulse; (c) aortic or subaortic stenosis; (d) patent ductus arteriosus without dilatation of the pulmonary artery; (e) idiopathic hypertrophy; (f) isolated interventricular septal defect.

3. Persistence of the right aortic arch.

4. Dextrocardia with or without transposition of the viscera (situs inversus).

Under each of these headings the authors discuss the physical signs, circulatory dynamics, and electrocardiographic findings, as well as the angiocardigraphic aspects, the correlation of which will usually permit an accurate diagnosis of the predominant lesion.

Evaluation of Roentgen Studies in Heart Disease in Children. Sol P. Dittowsky and Edwin Rypins. *Illinois M. J.* 84: 367-372, December 1943.

Examination of the heart in 532 children at the Illinois Soldier's and Sailor's Children's School was made by means of roentgenographic, fluoroscopic, electrocardiographic, and stethographic studies. Changes in cardiac contour were classified according to the standard nomenclature of the American Heart Association.

Thirty-nine per cent of the group, or 208 children, showed abnormalities of cardiac contour. Of these, 78 showed mitral configuration, 108 showed left ventricular enlargement, 16 had enlargement of the pulmonary conus, and 6 had globular configuration. All of the last two groups had systolic murmurs. In the other two groups there were 4 with no physical findings and 3 with apparent functional murmurs, the remainder having various organic murmurs. Three hundred and twenty-five children showed no roentgen abnormalities. Of these, 139 showed no abnormal findings clinically; 62 had murmurs which were probably functional, and the remainder probable organic murmurs. Only 8

per cent (21 cases) of the 225 patients with evidence of mitral disease showed deviation of the esophagus.

Summarizing their observations, the authors state that abnormal cardiac contour is evidence of cardiac disease, though the latter may exist without such roentgen changes. Roentgen studies are an important aid in diagnosis, as the typical auscultatory findings may be absent or overlooked.

Case histories, illustrated with x-ray reproductions, are presented, showing the value of repeated roentgen examinations of the heart in evaluating the status of a convalescent patient.

LESTER M. J. FREEDMAN, M.D.

Coarctation of the Aorta in Childhood. Review of the Literature and Report of Three Cases. Paul H. Rhodes and Edgar Durbin. *Am. J. Dis. Child.* 64: 1073-1096, December 1942.

A review of the literature on coarctation of the aorta revealed 47 cases in which the adult or "compensating" type had been diagnosed during life in children under fifteen years of age.

When coarctation of the aorta is pronounced enough to give clinical signs, its diagnosis is not difficult if the condition is kept in mind. It should be suspected when forceful pulsations in the neck and hypertension, particularly with a wide pulse pressure, are observed in a child. The presence of a much lower blood pressure in the legs and of retardation and diminution of pulsation in the femoral arteries confirms the diagnosis. The finding of a collateral circulation and the roentgenologic signs are valuable aids. Fray (*Am. J. Roentgenol.* 24: 349, 1930) considered a defect in the aortic arch seen in the left postero-anterior oblique film the most reliable roentgen sign of coarctation in the adult. In young children, however, it is frequently difficult to outline the aortic arch. The authors found that it often can be seen best in a film taken midway between the left postero-anterior oblique and the lateral position. Hypertrophy of the left ventricle, dilatation of the ascending aorta, and erosion of the lower margin of the ribs are indirect signs. Erosion if present is considered pathognomonic of coarctation, but its absence does not rule out the condition.

If routine determinations of blood pressure in children are made on only one arm, the right arm should be used, in order to avoid overlooking the occasional cases of coarctation in which the pressure is low in the left arm. Such a case is reported in a nine-year-old boy, with two other cases of coarctation of the aorta of the adult type in children of eleven months and four years, respectively.

It is important to diagnose coarctation as early in childhood as possible, since the life of the patient may be prolonged by avoidance of strenuous sports and occupations.

Nonsyphilitic Aneurysm of the Aorta in Individuals Under 45 Years of Age. M. F. Steinberg, A. Grishman, and M. L. Sussman. *J. Thoracic Surg.* 12: 704-713, December 1943.

Aneurysm of the thoracic aorta is usually due to either syphilis or atherosclerosis. Syphilis is more common as the cause in patients under forty-five years of age and atheroma in the older groups. The authors report four cases, reproducing roentgenograms of each, of nonsyphilitic aneurysms in patients less than forty-

five. Two were located just beyond the arch, one in the posterior part of the arch, one in the innominate artery. In one case the aneurysm was located and was verified by angiocardiology and exploration. It was treated by wiring and electrocoagulation. One was considered to be a traction aneurysm at the site of the ductus arteriosus. This case was also verified by angiocardiology and exploration. The aneurysm of the innominate was verified by exploration and post-mortem examination. Angiography in this case was of no help in the diagnosis. One case was verified by angiocardiology only.

HAROLD O. PETERSON, M.D.

THE DIGESTIVE SYSTEM

Dyspepsia: An Investigation. Harold Edwards and W. S. C. Copeman. *Brit. M. J.* 2: 640-642, Nov. 20, 1943.

The authors introduce this discussion with the statement that dyspepsia is one of the most important of the many problems that confront a populace during wartime.

In a 30-bed ward 436 dyspepsia patients were seen in one year. Complete diagnostic procedures were recorded and classifications were set up. There were 217 non-ulcer and 139 ulcer cases. The remaining 80 cases were not included in the report. Of the 217 patients without ulcer, 180 showed no physical disease and in the remaining 23 the diagnosis was usually gastritis or duodenitis.

In the investigation of the non-ulcer group the following conclusions were reached. Civilian occupation, marital status, and war service are not significant from the standpoint of causation. The average duration of a case of non-ulcer dyspepsia is six years, and the family history is suggestive. Eating and drinking habits are of doubtful significance. Pain has a more apparent relation to food and sleep in ulcer cases than in non-ulcer dyspepsia. Cases of both types are relieved by alkalis.

The authors seem to regard the x-ray findings as of primary importance but have no use for the term "duodenitis". The gastroscope is employed in all radiologically negative cases.

Q. B. CORAY, M.D.

Immersion Blast Injuries of the Abdomen. D. R. Webster, A. S. Ross, and E. L. Alford. *Canad. M. A. J.* 49: 1-4, July 1943.

The authors report their observations on 15 survivors of a torpedoed ship who sustained abdominal injuries from an exploding depth charge while in the water. The men were at varying distances from the ship—some still alongside and others 150 feet distant. Almost all turned to watch the ship as it went down, thus facing in the direction of the explosion, the depth of which is placed at 150 feet. All stated that they felt as if they had been struck a tremendous blow in the abdomen. The majority had only moderate abdominal pain in the first few hours after the accident, but shortly after being rescued, all experienced severe pain and vomiting, the vomitus in several instances containing blood and bile. Distention occurred in 5 and almost all had rigidity of the abdominal wall at some time. Blood counts varied from 11,000 to 30,000.

Four patients died, one on the first day, one on the second, one on the fifth, and one six weeks later. Four had protracted periods of convalescence and still had

mild symptoms five months after the injury. Histories of these 8 cases are included. Seven recovered readily without surgical intervention and were discharged from the hospital in three to fourteen days.

There was almost complete absence of chest symptoms, probably because of the protection afforded the kapok life preservers which were worn. It is suggested that it might be well to extend these life preservers so that they cover the abdomen.

In the four cases with protracted convalescence, which the white count and sedimentation rate remain elevated, accompanied by fever and loss of weight abdominal pain, tenderness and rigidity, but without physical signs of abscess formation, it is the authors' opinion that a low-grade inflammatory process is present in the bowel wall or peritoneal cavity.

The authors point out that submucosal and petechial hemorrhages interfering with the neuromuscular mechanism could produce ileus. They believe that within twelve hours it should be decided which cases require operative interference, and doubtful cases should have the benefit of a laparotomy.

M. L. CONNELLY, M.D.

Effect of Anemia on Gastric Emptying. Leon Jacobson and Walter Lincoln Palmer. *Gastroenterology* 1: 1133-1140, December 1943.

A study of gastric emptying in anemia was made in an attempt to determine whether or not the apparent relationship between anemia, gastric emptying, and symptoms is coincidental or real. Observations were made on 15 patients with pernicious anemia in relapse: the same patients after return of the blood count to normal following therapy, and an equal number of patients with pernicious anemia under control for months to years. Normal medical students and patients with moderate to severe anemias, the etiology and pathogenesis of which are not fully understood, were used as controls.

Having had nothing by mouth since midnight, the patient was given 4 c.c. of a barium sulfate drink (2 per cent barium by volume) between 8 and 9 A.M. The material was taken within a period of five minutes and a fluoroscopic examination was made at once and at intervals thereafter until the stomach had entirely emptied or only traces of barium remained. Fluorocopy was done with the patient standing, facing the examiner, with the back directly against the fluoroscopic cabinet and the fluoroscopic screen directly in contact with the abdomen. Sketches of the stomach and duodenum were made on the screen by means of a colored wax pencil with each examination in all patients; the rate of passage of the medium through the small bowel was noted in seven. The sketches were later transferred to paper and subsequent sketches upon the same patient were superimposed on the original for comparison.

Contrary to the general belief that gastro-intestinal motility is increased and the passage of material from the stomach and through the intestinal tract is accelerated in pernicious anemia, these functions were found either to be normal or delayed in severely anemic persons in relapse. With one exception, significant prolongation of the emptying time was observed in those patients with a peripheral erythrocyte count below 1,500,000. A similar observation was made in the anemias of obscure etiology. The gastric emptying time in the normal students and in the patients with pernicious

anemia under treatment and in full remission varied from two to four hours. In 6 of the 15 patients with pernicious anemia in relapse the emptying time exceeded four hours, averaging six and a half hours. In all of these, when the anemia disappeared under treatment, the emptying time returned to normal, the average being reduced from six and a half to two and seven tenths hours. No consistent relationship between the degree of abdominal symptomatology, the type or severity of the anemia, and the emptying time appeared to exist, although the majority of the patients with prolonged gastric emptying did have abdominal symptoms of varying severity. The impression that patients with pernicious anemia in relapse or remission are subject to attacks of diarrhea perhaps accounts for the prevalence of the opinion that gastro-intestinal motility is increased, with consequent rapid emptying. In no instance in the achlorhydric group was gastric emptying found to be more rapid than in the normal controls.

Peptic Ulcer and Chronic Gastritis. Vincent P. Collins. *Ann. Surg.* 118: 1005-1014, December 1943.

The term chronic gastritis has been applied by the clinician, the pathologist, the radiologist, and the gastroscopist to a wide variety of conditions in which the elements of inflammation, congestion, edema, and cellular infiltration are predominant. In an attempt at clarification the author reviews the findings in 213 stomachs resected for various conditions.

A detailed microscopic study of these specimens revealed a number of changes in the gastric glands which at first appeared to be of little significance, but when arrayed in a sequence of increasing severity formed an uninterrupted series of lesions suggesting a single disease process, to which the term chronic gastritis seems applicable. The minimal lesions consisted of scattered glands lined by epithelial cells undifferentiated into chief and parietal cells. Scattered glands were also observed undergoing a process of vacuolar degeneration which was occasionally found to have progressed to so complete a degree that only the ghost of the gland persisted. These changes were believed to be compatible with a normal process of degeneration and repair in gastric mucosa. The process of degeneration is sometimes associated with an infiltration by polymorphonuclear leukocytes. This may involve a number of adjacent glands and amount to a focus of necrosis which may border on focal ulceration of the mucous membrane.

The minimal lesions recognizable grossly are focal ulcerations involving the mucosa, which in the healed state are identifiable as a network of shallow fissures with intervening mounds of mucosa, presenting a pebbled or umbilicated appearance. The even progress of this series of ulcerated and healed lesions is maintained by ulcerations or scars which may extend through the muscularis mucosae to the submucosa, and to or even through the muscular coat.

When the degeneration and the necrosis are overwhelming and the mechanism of repair is inadequate, a recognizable peptic ulcer is the result. The peptic ulcer is thus only the most obvious manifestation of chronic gastritis and symptoms of peptic ulcer may be present without the gross lesion.

Hypertrophic gastritis is considered to be a mechanical alteration in the gastric mucosa, but atrophic gastritis is an integral and late stage of chronic gastritis.

G. A. CREEL, M.D.

Ulcer in the Descending Duodenum. Chamcey N. Bornum. *Am. J. Roentgenol.* 50: 752-764, December 1943.

The small number of reported cases of ulcer in the descending duodenum diagnosed by roentgen examination compared to the necropsy incidence suggests that in many instances these ulcers may have been overlooked. The author reports 7 cases recently seen by him of active ulcer in the upper descending duodenum, all demonstrated roentgenologically. In each instance the location of the crater was on the upper and inner margin of the descending duodenum just below the superior flexure. Secondary spasm, mucosal distortion, and medial retraction of the adjacent upper descending duodenum were present in all cases. In 3 instances the location of the crater was confirmed by surgical inspection. Macroscopic hemorrhage occurred in 6 of the 7 cases and nocturnal pain was prominent in 4. The roentgen differential diagnosis must take into consideration diverticula, cancer, visualized ampulla of Vater, and duodenitis. Detection of the niche is the important factor in establishing a diagnosis of active ulceration. Illustrative roentgenograms and three case reports are included.

L. W. PAUL, M.D.

Carcinoma of the Duodenum. J. W. Howard. *Am. J. M. Sc.* 206: 735-746, December 1943.

Carcinoma of the duodenum was found to account for 37 per cent of the cancers of the small bowel reported in the literature, as against 35 per cent in the jejunum and 28 per cent in the ileum. The periaampullary portion is the most frequent site.

Carcinomas of the duodenum probably do not arise from duodenal ulcers and are seldom associated with polyposis. Hyperplastic or neoplastic involvement of Brunner's glands is rare and probably has no bearing on the etiology.

The stenosing type of tumor, which usually infiltrates the submucosa and tends to encircle the lumen, is the most frequent type. Ulceration and scarring are common. Carcinoma of the papilla, on the other hand, usually involves only a portion of the intestinal wall. In general, metastases are late and chiefly involve the regional lymph nodes before other adjacent structures are invaded.

This disease occurs more often in males, the average age falling in the sixth decade. In the majority of cases the tumor is quite large when discovered, since symptoms are uncommon as long as the lumen of the bowel is adequate. Vague epigastric distress, with occasional attacks of pain, anorexia, and loss of weight are usually present. There is usually a moderate to marked anemia, perhaps due to ulceration, since occult blood in the stools is a rather consistent finding. Jaundice is rare, even with involvement of the periaampullary region, except as a terminal event. Obstruction of the bowel may occur as the lesion progresses.

The x-ray examination has been positive in less than half of the cases reported. Depending on the stage of the disease and the amount of the deformity, the following findings may be expected: (1) dilatation and vigorous reverse peristalsis when the tumor produces obstruction; (2) filling defect or, more commonly, an irregular constriction, frequently resembling an ulcer.

Several patients have survived following operation.

Three cases which came to autopsy are reported.

BENJAMIN COPLEMAN, M.D.

Small Intestinal Enema. Richard Schatzki. *Am. J. Roentgenol.* 50: 743-750, December 1943.

The author describes a method for examination of the small intestine which has been found to be of value in the diagnosis of lesions involving that part of the gastro-intestinal tract. It consists in the introduction of a soft rubber tube into the duodenum through the mouth. When the tip of the tube has reached the duodenum a thin barium and water mixture is injected. This consists of one glass of the usual barium mixture diluted with two glasses of lukewarm water. The mixture is allowed to flow by gravity and 500 to 1,000 c.c. are necessary for examination of the entire small bowel. Reflux into the stomach sometimes occurs and may occasionally be quite disturbing. Filling of the bowel is observed roentgenoscopically, with intermittent observations, until the entire small intestine has been completely filled. The earliest filling of the cecum occurred in five minutes. In most pathologic cases, considerably more time was required, the average being thirty-seven minutes in 19 checked cases. Constant flow of the enema fluid is necessary, and any interruption will delay the examination markedly.

With this method it is possible to study the entire small intestine within a relatively short space of time. Actual filling of the various loops can be observed roentgenoscopically and small lesions of various types can be recognized more readily than with the conventional procedure. Contraindications include marked mechanical or paralytic ileus, suspected gangrene of the bowel, and active duodenal ulcer.

The author credits Pesquera (*Am. J. Roentgenol.* 22: 254, 1929. *Abst. in Radiology* 14: 435, 1930) with first recommending the use of the duodenal tube for continuous filling of the small intestine for the purposes of roentgen examination. L. W. PAUL, M.D.

Volvulus of the Sigmoid Colon: Discussion of Combined Volvulus and Hepatodiaphragmatic Interposition. J. G. Probststein and H. R. Senturia. *Surg., Gynec. & Obst.* 77: 669-672, December 1943.

The authors report 2 cases of volvulus of the sigmoid colon, one of which was associated with hepatodiaphragmatic interposition of the colon.

The first patient was a 32-year-old white male who was admitted three times within six months with a typical picture of intestinal obstruction. On two of these admissions the colon was found to be above the liver radiographically. On the first admission operation was carried out, with reduction of the volvulus. On the second, conservative measures were used and the obstruction was overcome. The third time the patient consented to resection of the redundant sigmoid loop. The second patient, a 26-year-old white male, was admitted twice within a year, each time presenting a picture of intestinal obstruction. The first attack was relieved by operation, with reduction of the volvulus and replacement of the bowel. The second attack was relieved by resection of the redundant sigmoid. Resection was followed in each instance by a normal course.

The authors point out that hepatodiaphragmatic interposition of the colon is usually an incidental finding which must be differentiated from air under the diaphragm due to perforation of a viscus. Volvulus of the sigmoid occurs in patients with a long redundant sigmoid colon and is more common in Russia than in this country. Immediate resection of the loop is recommended, because of the possibility of recurrence.

The roentgenograms illustrating this article are only fair reproductions. JOHN O. LAFFERTY, M.D.

Polypoid Lesions of the Colon of Children. Roger L. J. Kennedy, Claude F. Dixon, and Harry M. Weber. *Surg., Gynec. & Obst.* 77: 639-644, December 1943.

The authors report the experience of the Mayo Clinic with 11 cases of polypoid lesions of the colon in children. The patients were from 3 to 14 years of age, and included 4 girls and 7 boys. Symptoms had been present for variable periods from a week to seven years. The most common symptom was blood in the stools, usually small in amount and on the outside of the stool or at the end. In only one case was bleeding severe enough to require transfusion. Pain and diarrhea were not common.

There are three important points in the diagnosis of these polypoid lesions. First, the history is important and characteristic. The blood is fresh and is not mixed with the stool. There is no diarrhea. Second, in 6 of the 11 cases polypoid lesions were present in the rectum and were revealed by proctosigmoidoscopy. The third method of diagnosis is the roentgen examination.

The authors describe roentgen examination of the colon in children as follows: The colon is thoroughly cleansed by purgative drugs, of which castor oil in doses ranging from 15 to 30 c.c. is preferred, followed by a simple enema of physiologic salt solution on the morning of the examination. The barium enema should be given under fluoroscopic control, and the patient palpated and rotated so that all parts may be studied. At the completion of the examination the patient should empty the bowel; the contents should not be siphoned off. Not more than five minutes should be allowed for evacuation, as the barium suspension will be dehydrated and the material will collect in clumps. The patient is then insufflated with air and stereoscopic roentgenograms are made. The authors use suspending agents with the enema and give pentobarbital sodium in doses of 0.75 to 1.5 grains if the children are difficult to handle.

The treatment of these lesions is transcolonic excision or resection of the involved segment, the procedure depending on their extent. These polyps are usually adenocarcinomas of low-grade malignancy according to the classification of Broders, though a few are simple adenomas.

The results in this series of cases have been good. JOHN O. LAFFERTY, M.D.

Neurofibromatosis of the Colon, Small Intestine and Mesentery in a Child. Thomas Chalkley and James W. Bruce. *Am. J. Dis. Child.* 64: 888-894, November 1942.

A case of neurofibromatosis of the colon, small intestine, and mesentery in a child is presented. A negro girl, age 8, was admitted to the hospital, with an infection of the upper respiratory tract. At that time there was found an asymptomatic, irregular, nontender, hard, freely movable mass extending from the umbilicus laterally for 12 cm. It was not fixed to the skin and seemed to be a part of the intestine. Roentgenograms of the gastro-intestinal tract showed narrowing of the terminal portion of the ileum, which was irregular in contour and moderately fixed. The cecal tip was irregular, and the whole picture was characteristic of a terminal ileitis. A barium enema showed no

abnormalities except the condition in the cecum. Intravenous pyelograms showed prompt and satisfactory output of the dye into both renal pelves. There was a congenital anomaly of both kidneys, consisting of a bifid pelvis on the left side and on the right a double kidney and a double ureter, which extended down to the level of the fourth lumbar vertebra. At this point there was apparently an obstruction, causing a hydro-ureter.

A complete resection of the colon with the terminal 2 feet (60 cm.) of the ileum and the involved mesentery was done. The pathologic diagnosis was neurofibromatosis of the colon, cecum, small intestine and mesentery. At the time of this report, the child was doing well. There was no familial history of neurofibromatosis.

Pheniodol: A New Contrast Medium for Cholecystography. F. H. Kemp. *Brit. M. J.* 2: 674-676, Nov. 27, 1943.

Pheniodol is the name applied to the various British preparations of the cholecystographic medium introduced by Dohrn and Diedrich in Germany, where it is known as Biliselectan (manufactured in America as Priodax). The author's observations on this new medium, as prepared by several different British drug houses, are closely in accord with the findings of American investigators (see papers by Bryan and Pedersen, Paul and Pohle, and Hefke in *Radiology* 42: 224, 226, 233, March 1944). It was found to produce shadows similar in density and filling to those obtained with tetraiodophenolphthalein. Though some patients complained of a disagreeable taste, the new medium was less objectionable to take than the older one. It seldom caused vomiting and, though diarrhea followed its use in some instances, this occurred with no greater frequency than after tetraiodophenolphthalein.

The author includes a review of cholecystographic media beginning with the original studies of Graham, Cole, and Copher.

Gall Bladder Functions After Sub-Total Gastrectomy: Clinical and Roentgenological Observations. I. R. Jankelson and S. A. Robins. *Am. J. Digest. Dis.* 10: 445-447, December 1943.

In order to determine the effect of partial gastrectomy upon the functions of the gallbladder, cholecystographic investigations were done on 15 patients upon whom this operation had been performed. None of these patients had a diseased gallbladder at the time of operation. The gallbladder filled normally in all but one case; there was delayed emptying in two cases. The authors have observed in their clinical work four cases of cholelithiasis in patients who have had a partial gastrectomy in whom no evidence of gallbladder disease was found at operation. From the study of this small group of cases, they conclude that subtotal gastrectomy may interfere with the normal function of the gallbladder leading to infection or gallstone formation.

JOSEPH T. DANZER, M.D.

THE SPLEEN

Solitary Calcified Cyst of the Spleen. P. O. Snoko. *Am. J. M. Sc.* 206: 726-730, December 1943.

The author reports a solitary calcified cyst of the spleen in a 60-year-old white woman who was slightly icteric. The large area of calcification noted in the

roentgenogram was said to have been absent in an examination made two years before. It is thought that the cyst may have been hemorrhagic in origin, and the calcification recent.

Only 5 other cases have been reported in the literature. The age incidence is not restricted to any one group. Four of the patients have been women. The roentgenographic appearance is very difficult to differentiate from that of a calcified aneurysm of the splenic artery.

BENJAMIN COLEMAN, M.D.

THE SKELETAL SYSTEM

Paget's Disease of Bone (with Report of Case). James Miller. *Canad. M. A. J.* 49: 13-16, July 1943.

There appear to be two forms of Paget's disease, the common monostotic form, involving one bone of the skeleton, and the rare polyostotic variety, involving several bones. Osteitis deformans, the term suggested by Paget, is somewhat misleading, as the pathological changes do not suggest an inflammatory process.

The disease is one of later life and seems to be more common in males. In America it is reported more often in the northern states. Paget stated that the disease is not associated with mental trouble. In his series of cases no hereditary tendency was found. The author, however, presents a case with a familial history.

According to Paget, the long bones of the lower extremity and the skull are most frequently involved. The bones increase in length and thickness; they are heavier than normal, and the bone is more vascular, more porous, and softer.

Microscopically the earliest change is the appearance of osteoclasts or multinucleated bone cells which hollow out and remove normal bone. The bone and intervening marrow are replaced by fibrous tissue and while some bony trabeculae are being removed by osteoclasts new ones are laid down by osteoblasts. This new bone is composed of alternate denser and less dense layers, giving a mosaic structure when stained with hematoxylin, a condition found in no other disease.

Radiographically, the early finding is an osteoporosis; later there is the appearance of new bone replacing the old. There are two forms of this new bone, spongy and amorphous, the former being more common.

Of associated conditions, arteriosclerosis appears to be most constant, usually of the Mönckeberg type. There appears also to be a definite association between Paget's disease and malignant neoplasia, the bone dystrophy being the earlier condition.

The only chemical test of value, according to Jaffe, is determination of the serum phosphatase, which is frequently twenty times the normal. This test is not specific, however, as high values are also reported in osteitis fibrosis cystica.

M. L. CONNELLY, M.D.

Late Rickets. Elizabeth Brakeley. *Am. J. Dis. Child.* 65: 314-319, February 1943.

A case of late rickets in a girl of 11 years is reported. The patient's development was retarded; she did not walk or talk until she was three years old. She had been treated for gonorrheal vaginitis and marasmus and had received several series of antisyphilitic treatments. At the age of ten, she was seen in the outpatient department because of a waddling gait. A roentgenogram of the pelvis on that occasion was normal.

In June 1936, at the age of 11, the patient was again

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seen because of swelling and tenderness of the knees and ankles. Roentgenograms of the extremities showed florid rickets, with cupping and saucer-shaped appearance and some increased density of the diaphyses. There was a slight hypochromic anemia. The calcium content of the serum was 11.2 mg. per 100 c.c., and the phosphorus content was 3.29 mg. A twin brother showed no signs of rickets.

The patient remained in the hospital for three and a half months and received large doses of vitamin D, up to 4 c.c. of viosterol in oil (40,000 U.S.P. units of the vitamin) a day, and ultraviolet ray treatment. Roentgenograms taken in September 1936, June 1937, and January 1938 showed healed rickets. The child continued, however, to show extreme decalcification of the bones, a high serum calcium level, a low level of serum phosphorus and a high serum phosphatase level. This was attributed to hyperparathyroidism secondary to the rickets, but operation (March 1939) failed to reveal any parathyroids. Since permission for a second exploratory operation was refused, it was decided to use roentgen therapy and in November 1939, 800 r was administered to the right side of the neck, followed three weeks later by 800 r to the left side. Examination of the blood in January 1940 revealed definite improvement and roentgenograms taken in February 1940 showed a moderate increase in cortical density of the tibia, fibula, radius, and ulna. In June 1940 the serum calcium was again elevated and the serum phosphorus decreased. The neck was irradiated twice, with the same dosage as before. In October 1940 the calcium level was the lowest since the condition was recognized. A roentgenogram of the extremities showed that, while there was still some evidence of osteoporosis in all the long bones, there was a considerable increase in the thickness and density of the cortex throughout. At the time of this report, the patient felt well, had no pain in her knees, and walked without difficulty.

Intractable Hypophosphatemic Rickets with Renal Glycosuria and Acidosis (the Fanconi Syndrome): Report of a Case in Which Increased Urinary Organic Acids Were Detected and Identified, with a Review of the Literature. D. J. McCune, H. H. Mason, and H. T. Clarke. *Am. J. Dis. Child.* 65: 81-146, January 1943.

The present report, under the heading *Progress in Pediatrics*, describes a case of severe hypophosphatemic rickets in a 9-year-old boy, associated with renal glycosuria and extreme reduction of the bicarbonate in the serum. Although moderate polyuria, albuminuria, and cylindruria were normal, the urine was acid and contained exaggerated amounts of ammonia and organic acids. Of these 82 per cent were amino acids, 11 per cent lactic acid, and 7 per cent beta-hydroxybutyric acid. Slight reduction of fixed base and sodium in the serum was demonstrated. A balance study revealed excessive excretion of phosphorus and calcium by the kidneys. The metabolism of sodium, chlorine, and magnesium appeared to be unaffected. Treatment with 5,000 U.S.P. units of vitamin D daily for several weeks had no obvious effect; other therapeutic recommendations were not carried out. The patient died at the age of 10 years and 1 month; no autopsy was performed.

The data are interpreted to indicate diminished

ability of the renal tubular epithelium to resorb dextrose, amino acids, and phosphate from the glomerular filtrate. Inasmuch as the requirement of cation to neutralize the organic acids was not met by the production of a highly acid urine, large amounts of ammonia and increased urinary volume, mineral cations of the body fluids were called on, with resultant depletion of fixed base. Recurrent hypoglycemia was thought to be responsible for the excretion of beta-hydroxybutyric acid. The presence of lactic acid was ascribed hypothetically to either renal tubular or hepatic dyscrasia.

The literature of the last fifteen years contains references to or detailed descriptions of 28 cases which are comparable with the foregoing so far as they are characterized by rickets and renal glycosuria, and 2 cases in which rickets was replaced by osteoporosis in adults.

A review of the literature supports the concept of the central role of the kidneys in the pathogenesis of the Fanconi syndrome and of allied disorders; interpretation of the significance of the hepatic damage which some patients exhibit requires further evidence. However, critical examination of the data of this case and of others which have been reported indicates that renal tubular resorption of phosphorus is more seriously compromised than that of cation. This distinction has an important bearing on treatment. Finally, it is apparent that the Fanconi syndrome, with its combination of rickets, hypophosphatemia, and renal glycosuria, is not a sharply definable clinical entity. On the contrary, it appears to be one phase, or aspect, of a larger morbid species and merges without perceptible demarcation on the one side with classic hyperphosphatemic renal rickets and on the other with the poorly understood process which is currently called cystine rickets.

Abstracts of previously reported cases of the Fanconi syndrome and allied disorders are included.

Osteochondrosis Deformans Tibiae. Nonrachitic Bow Leg in Children. C. Glenn Barber. *Am. J. Dis. Child.* 64: 831-839, November 1942.

Osteochondrosis of the medial tibial condyle is the most common cause of development of bow leg during childhood in localities where rickets due to vitamin D deficiency is seldom seen. Many times the true condition is unrecognized and, although the children have received adequate amounts of vitamin D and although other evidence of rickets is wanting, the deformities of the legs are attributed to that disease.

The changes observed in osteochondrosis of the medial tibial condyle are definite and need not be confused with those seen in rickets, whether due to deficiency of vitamin D or of the renal or the colonic variety, nor should they be confused with the deformities which may accompany dyschondroplasia, achondroplasia, fragilitas ossium, or osteogenesis imperfecta.

The roentgenographic and pathologic changes are like those of coxa plana and those in the many bones similarly involved. When the tibial condyles are involved, two distinct types occur. These two types are dependent on the age at which the condition becomes manifest and have been designated as the infantile and adolescent types of the disease "tibia vara." Gradually increasing bowing occurs, without apparent cause and without the other symptoms of rickets. The deformity is likely to appear bilaterally in the infantile type, frequently with subsequent spontaneous disap-

pearance of the bow leg on one side. In the adolescent type the angulation usually occurs on one side only. There is a limp if the condition is unilateral and a waddle if it is bilateral. There is an abrupt angulation with the apex laterally just below the knee joint, but in fat children this appears to be a gradual curve. When the deformity appears during infancy, enlargement of the medial condyle is palpable on physical examination and visible in the roentgenogram. Recurvatum at the knee and relative flatfoot are present, irrespective of age. Abnormal mobility of the knee on medial strain with normal stability on lateral strain and inward rotation of the tibia on the femur are constantly observed. The roentgenographic and pathologic changes are like those of coxa plana and similar to those of dyschondroplasia but quite different from those of rickets. Faulty growth of the upper tibial epiphyseal cartilage and delayed ossification of its medial half result in a wedge-shaped deformity of this portion. The adolescent type looks different in the roentgenogram. It appears as an arrest of growth rather than a dysplasia. The roentgenographic features of the infantile type gradually change to those of the adolescent type so that the two can be distinguished later only by the history.

Treatment of osteochondrosis deformans tibiae depends on the stage of the disease. Measures to prevent further deformity or to correct existing deformity have proved effective during the plastic stage. When deformity is disabling or unsightly after the osteochondrosis has become arrested, tibial osteotomy is advisable.

Monocytic Leukemia Associated with Bone Changes.

Robert J. Kositchek. *Ann. Int. Med.* 19: 1008-1013, December 1943.

A 19-year-old boy with monocytic leukemia complained of pain and limitation of motion in the right arm and shoulder and pain and weakness in both hips and thighs. He experienced difficulty in walking and the gait is described as shuffling and spastic. Roentgen examination showed osteolytic lesions in the surgical neck of the right humerus, involving the medullary portion of the bone; less extensive changes, possibly due to osteoporosis, in the upper third of the femur; osteoclastic changes in the right clavicle and in the surgical neck and head of the left humerus. Stereoscopic studies of the pelvis revealed circular areas of bone destruction in each ischium and about the right acetabulum. Similar changes were seen in the head, neck, and inter-trochanteric region of each femur. In the skull were several rounded areas of translucency representing bone destruction in the parietal region bilaterally. A similar area was seen in the inferior portion of the parietal bone anteriorly, just above the squamous portion of the temporal bone.

Roentgen therapy to the extremities resulted in relief of pain and the gait became normal. Death occurred a few months later but autopsy was not obtained.

This case, as far as could be ascertained, is the first in the literature of an associated monocytic leukemia and bone absorption. The softening and absorption in the medullary portion of many of the long bones, the increased porosity produced by widening of the haversian canals, and the cystic changes which may be indicative of neoplastic invasion have been noted in cases of lymphocytic and myelogenous leukemia, but are new to monocytic leukemia as a clinical entity.

The relief which was given to the patient by roentgen-ray therapy over the painful extremities leads to the suggestion that roentgenographic studies should be undertaken in cases of monocytic leukemia with painful bony areas.

STEPHEN N. TAGER, M.D.

Gaucher's Disease. Samuel Levine and Leon Solis-Cohen. *Am. J. Roentgenol.* 50: 765-769, December 1943.

Two cases of Gaucher's disease are reported, one showing typical bony changes and the other several atypical findings. In the first instance, roentgenograms of the lower ends of the femurs showed the typical Erlenmeyer flask deformity. In the other case there were multiple areas of punctate osteolysis symmetrically distributed throughout the shaft of the humerus on either side and scattered isolated osteolytic areas in many of the other long bones but with an absence of the Erlenmeyer flask appearance in the lower ends of the femora. The skull showed minute areas of bone absorption in the frontal and parietal region. The diagnosis of Gaucher's disease in this case was proved only after bone biopsy. L. W. PAUL, M.D.

Pseudocongenital Dislocation of the Hip in Infants. Joseph H. Lapin. *Arch. Pediat.* 40: 649-652, December 1943.

The author deals here with the borderline case in which clinical findings may hint at a beginning hip dislocation but the roentgenogram is negative. Among the clinical findings which have been stressed are: lack of symmetry as compared with the normal leg and unsymmetrical transverse creases. The term "potential dislocation" has been applied to cases in which the angle formed by the acetabular shelf with the horizontal plane is increased. This angle the author discusses with a note of caution. Though some advocate orthopedic management in all children in whom the angle exceeds 30 degrees, such patients have been known to escape dislocation without treatment.

Three cases are reported. In the first, there was definite asymmetry of the legs and transverse creases were observable on the left leg but not on the right. Roentgenography, however, definitely ruled out any type of dislocation or predislocation. The second patient, a child of seventeen months, walked with a waddle, with the right foot everted almost at a right angle, and had an apparent shortening of the right leg. The sole of the shoe on the affected side was raised and a hobble skirt employed; six months later, the gait had improved, though lack of symmetry was still evident. In the third case only elevation of the sole was resorted to, with a marked improvement after six months.

PERCY J. DELANO, M.D.

Subluxation of the Ankle. G. F. Pennal. *Canad. M. A. J.* 49: 92-95, August 1943.

This is a report of a series of 14 cases of subluxation of the ankle, the term subluxation being used to designate "injuries resulting in a complete tear of the external lateral ligament of the ankle with subsequent momentary or recurrent outward dislocation of the astragalus, unaccompanied by fracture."

The author discusses the anatomy of the external lateral ligament of the ankle and presents roentgenograms illustrating results of various types of injury to this ligament.

Differentiation between a subluxation and a simple sprain may be made from an anteroposterior roentgenogram taken with the foot held strongly in inversion. In normal ankles and in the presence of a simple sprain there is no tilting of the astragalus; with subluxation various stages of tilting are demonstrable, from the minor tilt with rupture of only the anterior fasciculus to the more common picture of subluxation associated with complete rupture of both fasciculi.

Treatment successfully used in this series was prolonged immobilization (ten weeks) in a walking plaster cast. Strapping alone is inadequate.

M. L. CONNELLY, M.D.

Ruptured Ligaments of the Ankle. A Roentgen Sign. R. P. Ball and E. W. Egbert. *Am. J. Roentgenol.* 50: 770-771, December 1943.

A spread of the tibio-fibular ankle mortise from torn ligaments may produce a permanently unstable ankle joint unless properly treated. This condition may be diagnosed from routine roentgenograms of the ankle joint area. If the anteroposterior view is made with the foot in a true anatomical position, a clear space between the malleoli and the talus is not seen unless there is a spread of the tibio-fibular mortise; in normal cases, there will be an overlapping of the shadows of one of the malleoli upon the talus. This sign may not be present in all cases with injury to the ligament but, when found, is positive evidence of soft-tissue injury of clinical significance.

L. W. PAUL, M.D.

THE GENITO-URINARY TRACT

Intravenous Pyelograms in Normal and Abnormal Pregnancies. Deborah C. Leary and John P. Peters. *Am. J. Obst. & Gynec.* 46: 803-809, December 1943.

The present study was undertaken to determine whether toxemia of pregnancy and urinary tract infection in pregnancy have any significant effect upon changes in the urinary tract generally accepted as physiologic. A group of 108 women in various stages of pregnancy and the puerperium were studied by intravenous pyelography. In 85 of these patients, pregnancy was in some way abnormal. Dilatation of the renal pelvis and dilatation, tortuosity, and lateral displacement of the ureter are listed as positive pyelographic findings. Cases with none of these changes are listed as negative.

Only 2 of the patients in the normal group were examined ante partum, and of these one is listed as showing positive (at 24 weeks) and one as showing negative findings (at 33 weeks). Of the abnormal group, 22 were studied ante partum and 16 gave positive findings (of the 6 with negative findings, 5 were examined before the 16th week). Post-partum examinations were made in 21 normal patients and 59 abnormal. In all but 6 of the normal group the observations were negative, indicating that regression of urinary tract changes is prompt in normal pregnancy. Of the abnormal group, on the contrary, 27 were positive and 32 negative. Neither the ante-partum or the post-partum studies showed any conclusive evidence that the degree of parity played a role.

Patients with urinary tract infection or pyelitis, as well as being included in the abnormal group, were tabulated separately. The trend evident in the abnormal series as a whole appeared to be exaggerated in the infected group.

In the entire series of 108 selected patients, one major and one minor urinary tract anomaly were found. One patient, otherwise normal, had bilateral polycystic kidneys. One patient with mild pre-eclampsia had a bifid pelvis and ureter on the right. In one patient with eclampsia, a calculus of the upper pole of the right kidney was discovered. In none of these was any evidence of infection present.

The authors conclude that urinary tract infection and toxemia enhance the normal tendency to dilatation of the urinary tract in pregnancy and interfere with the usual prompt regression of such changes.

STEPHEN N. TAGER, M.D.

Intravenous Urokinography. A Preliminary Report. Boland Hughes. *J. Urol.* 50: 621-624, November 1943.

A kymogram records on one film the movement of definite points of the urinary tract through thirty seconds of time, and so depicts the actual dynamic function. In order to give sufficient contrast for the kymogram, retrograde filling of the urinary tract was necessary when this method of study was first introduced. The author, in collaboration with the x-ray department, devised an intravenous technic which gave satisfactory results, in contrast to earlier intravenous methods which were only occasionally successful.

From 20 to 30 c.c. of diodrast or neopax are injected, and the patient is kept in the Trendelenburg position for fifteen minutes. Just before the kymogram is made, a change is made to the flat position.

The kymograph consists of a large lead sheet in which narrow horizontal slits are cut 12 mm. apart, each slit being 0.4 mm. in width. This "grid" is stationary, and the film cassette moves downward during a single continuous exposure of thirty seconds for a distance of 12 mm. There remains 0.2 mm. of unexposed film which shows up as a series of white horizontal lines. This is accomplished by having the x-ray exposure automatically stopped just before the film cassette traverses the full 12 mm. distance. The x-ray exposure is made by a high capacity, rotating anode tube. The other factors are 30 inch S.T.D., 25 ma., 60-100 kv., 1 mm. Al filtration, 30-second exposure.

DAVID KIRSH, M.D.

Primary Sarcoma of the Ureter. Case Report and Review of the Literature. Lee Rademaker. *Am. J. Surg.* 62: 402-406, December 1943.

A case of leiomyosarcoma of the ureter, the sixth case of primary ureteral sarcoma to be reported, is presented, with a review of the literature.

A white woman, aged 59, was admitted to the hospital, complaining of a heavy, dull ache in the upper left side of the abdomen, gas, and a lump in the side. The aching sensation had appeared about five months previously. The pain was at first intermittent and became progressively worse. One month before admission the patient noticed the presence of a mass, which felt like a ball. This had increased in size and had become very tender.

The abdomen was dome-shaped, with normal liver dullness. It was considerably distended with gas. A smooth, clearly defined mass, about the size of a large grapefruit, filled the left upper quadrant. This mass was not attached to the anterior abdominal wall and could be moved about 1 inch in all directions. It could not be moved, especially at the upper pole. It could not

be palpated posteriorly and there was no posterior tenderness. Pressure on the mass caused a definite pulsation to occur, transmitted probably from the aorta. Physical findings were otherwise negative.

All films of the abdomen showed the outline of a rounded mass in the upper left quadrant. An intravenous pyelogram showed a moderate hydronephrosis on the left side. On several roentgenograms, the left ureter was seen to end abruptly within the tumor. On the right side there was a moderate ptosis of the kidney with some kinking of the ureter.

Removal of the tumor was accomplished readily though it was complicated by severe hemorrhage. The postoperative course was uneventful, and fourteen months after the operation the patient was without detectable recurrence or metastasis. The pathological diagnosis was leiomyosarcoma of the ureter. Interesting features of the growth were its relatively few symptoms, its large size without obvious metastasis, its good encapsulation, and its low index of malignancy.

Cystourethrographic Diagnosis of Prostatic Disease. William E. Forsythe, Jr. *Urol. & Cutan. Rev.* 47: 669-673, December 1943.

Because of the close relationship between the posterior urethra and the prostate, pathological changes in the latter will produce urethral deformities making possible a urethrographic diagnosis. Often more information can be obtained by cystourethrography than by cystoscopy and with less risk and discomfort.

The technique is as follows. After routine preparation an abdominal plain plate is taken. The bladder contents are then withdrawn through a No. 12F soft rubber catheter, and the patient is placed in an oblique position with the lower thigh flexed to about 45 degrees and the upper thigh extended. The x-ray tube is focused over the symphysis pubis, air is injected into the bladder, and a second exposure is made. The catheter is then withdrawn, the air being retained in the bladder by compression on the terminal portion of the penile urethra, and 20 c.c. of hippuran jelly mixture is slowly injected and a third film is taken. During the exposure an additional 10 c.c. of the jelly is injected. The patient is then replaced in the dorsal position, the catheter is reinserted, the bladder is irrigated, and a routine cystogram is made after the injection of sodium iodide.

In the normal subject the urethrogram shows the urethral catheter entering the bladder neck straight. The prostatic urethra measures 3-4 cm. in length and is spindle-shaped with slight narrowing at the external and internal sphincter sites. The cystogram reveals a smooth vesical outline with no filling defect at the vesical orifice. The departures from this picture to be seen in various lesions of the prostate are described and illustrative aerograms and urethrograms are reproduced.

MAURICE D. SACHS, M.D.

VENOGRAPHY

Retrograde Venography of the Deep Leg Veins. J. C. Luke. *Canad. M. A. J.* 49: 86-88, August 1943.

The author presents his technique for retrograde venography. The Bucky diaphragm is used for radiography of the thigh and an ordinary intensifying screen for the lower leg. Venipuncture of the femoral vein is performed just below the superior ramus of the pubis, the puncture being made just medial to the femoral artery. The artery and vein are compressed against the superior pubic ramus, and the injection is then made quite easily without pressure. With the assistant still exerting pressure on the artery and vein, radiographs are made of thigh and lower leg. The solutions used are perabrodil and diodrast, as these entail less chance of trouble if some is accidentally injected outside the vein. This technique was used in 29 cases with no untoward reaction.

The valvular mechanism of the femoral vein and its tributaries allows retrograde flow of contrast media down the vein even in a normal leg, in contrast to the saphenous vein, where normal valves resist high pressure when retrograde injection is attempted.

The main indication for retrograde venography is the determination of the presence or absence of a previous "silent" femoral phlebitis. In such a case there is no normal femoral channel, this being replaced by a tortuous mass of collaterals which take over the function of the partially or completely obliterated main vein.

A case is reported in a soldier who had symptoms referable to the legs after an attack of pneumonia. Venograms illustrative of this and 6 other cases are reproduced.

M. L. CONNELLY, M.D.

RADIOTHERAPY

NEOPLASMS

Brocq-Belot's Technique in the Treatment of Superficial Skin Cancers. Paul Brodeur. *Canad. M. A. J.* 49: 109-110, August 1943.

This is a report of 32 cases of superficial cancer of the skin in which the primary lesion was treated by the Brocq-Belot technique. Of these cases, 22 were epidermoid-cell carcinomas and the remainder were basal-cell carcinomas.

A brief résumé is given of the Brocq-Belot technique. In cases where there is marked infection the wound is disinfected for twenty-four hours by wet compresses, vaccines, etc. Under local anesthesia the lesion, together with a border about 0.5 cm. in width, is curetted. Immediately following this, roentgen therapy is ap-

plied—1,200 to 1,800 r in one sitting. Only rarely is more treatment necessary, but in exceptional instances a second dose one-half the size of the first may be given in four to six weeks. The factors used in the author's series were 85 kv.p., 5 ma., filtration (inherent) 0.5 mm. Al, target-skin distance 28 cm., H.V.L. 0.84 mm. Al. The rate was slightly over 100 r per minute.

The author's cases were treated between the years 1935 and 1941. The results as of the date of the report (January 1943) were as follows. Of 27 patients with Stage I cancers, 18 were alive and well, 7 had died of intercurrent disease but with no skin cancer, and 2 were untraced. The 3 patients with Stage II and the 2 with Stage III lesions were all alive and free of cancer. The Stage III cases received, in addition, x-ray therapy to involved nodes. M. L. CONNELLY, M.D.

ABSTRACTS OF CURRENT LITERATURE

Carcinoma of the Breast: Treatment and Late Results. N. Puente Duany, Rafael Canizares, and Ernesto Fonts Abreu. *Rev. med. cubana*. 54: 882-892, October 1943.

Of a total of 602 patients with carcinoma of the breast, treated at the Radium Institute of Habana during the years 1924 to 1937 inclusive, 100 were found to be alive five years after treatment. Study of this group forms the basis for the opinions expressed in the present paper. The clinical diagnosis was in most instances confirmed histologically. In patients who applied for treatment after they had been operated upon elsewhere the diagnosis was established by recurrence or metastasis.

The bulk of the patients were treated by surgery followed by roentgen or radium irradiation. A greater number of five-year "cures" were found to follow this combined therapy.

Like other workers in this field, the writers found that certain factors show a beneficial influence on the outcome of treatment, as more advanced age of the patient, early diagnosis, non-existence of metastasis, and treatment by trained personnel with adequate equipment. On the other hand, a poor prognosis is suggested by a rapidly growing tumor, a young patient, especially if the growth developed during pregnancy or lactation, a high grade of malignancy, and existence of metastases. Twice as many five-year cures were obtained in patients with Grade 1 as in those with Grade 2 tumors.

The writers deplore the preference shown of late to the use of roentgen therapy over radium, especially in the treatment of axillary metastases and recurrences. They believe it is not justified. A. MAYORAL, M.D.

Carcinoma of the Thoracic Esophagus. Some Notes on Its Pathology and Spread in Relation to Treatment. J. A. C. Fleming. *Brit. J. Radiol.* 16: 212-216, July 1943.

Between 78 and 87 per cent of cancers of the thoracic esophagus are squamous epitheliomas. Practically all of the remainder are adenocarcinomas. There is usually a period of from six to nine months between the onset and the diagnosis. During this time extension to surrounding structures or metastasis usually occurs. Death ensues, on an average, five or six months after the diagnosis is made.

Autopsy studies on 42 cases showed metastasis in 83.5 per cent of lesions in the upper third; 71.5 per cent in the middle third, and 93.5 per cent in the lower third. In 54 per cent of the cases metastases were found in the mediastinal nodes; in 23 per cent in the abdominal nodes and in 4 per cent in the cervical nodes. The trachea and bronchi were involved in 25 per cent; the liver in 21 per cent; the lungs and pleura in 17 per cent; the stomach and adjacent viscera in 13.6 per cent; and other viscera in 6.7 per cent. Where the visible involvement of the esophagus exceeded 5 cm. in length, there was a material increase in distant metastases.

These figures indicate that there is very little chance of successful treatment of esophageal cancer by any method. There is only one proved example of a five-year survival following surgical removal, Torck's famous case. Only a few instances of successful treatment by radium are reported. The high percentage of metastasis would indicate that radium locally applied has little chance of being successful.

On physical and pathological grounds irradiating by x-ray appears to offer the best outlook. The author advocates many multiple narrow beams, varying the volume of tissue intensively treated with the probability of extension and the size of the primary growth. In a series of 21 cases so treated there was an apparent increase in the length of survival of between three and six months as compared with untreated cases. SYDNEY J. HAWLEY, M.D.

Radiation Treatment of Cancer of the Cervix. Norman A. McCormick. *Canad. M. A. J.* 49: 178-181, September 1943.

The first phase of treatment of carcinoma of the cervix was surgical. The second or radium phase developed as a natural sequence of unsatisfactory surgical experience. The third phase, consisting in the addition of adequate external roentgen irradiation to the use of radium, followed the realization that control of lymphatic involvement of the parametrium is the most important factor in the management of these cases.

As satisfactory means for the measurement of roentgen dosage have been developed, an improvement in the results has been observed. A technic of combined x-ray and radium therapy has been evolved, whereby it is possible to deliver a minimum of 5 to 8 skin erythema doses throughout the pelvis.

Roentgen irradiation should precede radium therapy, the daily dose being kept small—150 to 200 r—so that the tumor bed will be unaltered. The diminution in the size of the growth—at times amounting to complete disappearance—following such treatment makes for ease and accuracy in radium application. Devitalization of the tumor also makes possible dilatation of the cervix with more impunity and less risk of cancer dissemination.

The author uses six portals encircling the pelvis and occasionally adds two gluteal portals. Two portals are treated daily, each receiving 150 r at first, increased within a week to 200 r (200 kv., 20 to 25 ma., 1 mm. Cu plus 4.0 mm. Al, target-skin distance 80 cm.). The average treatment time for each field is about twenty minutes. Each portal receives 2,000 r, making a total pelvic dose of 12,000 r (in air). The 80 cm. distance between skin and x-ray target, while a rather costly technic, requiring four times the treatment time of an exposure at 40 cm., results in a considerably greater depth dosage and is a very essential part of the treatment.

Radium therapy is instituted one or two days following completion of x-ray irradiation: 100 mg. of radium filtered by 1 mm. Pt. in a gum-elastic applicator, is placed with proper precautions in the uterine cavity and cervical canal and allowed to remain for 30 hours. A second application to the vault of the vagina a day or two later brings the total dose to 5,500 or 6,000 mg. hr.

The series reported here numbered 135, of whom 77 were treated more than three years earlier. Excluding 2 of this number who were treated prophylactically after operation and 8 who had recurrent lesions on treatment elsewhere, the author bases his analysis on 67 cases. Twenty-nine patients of this group, or 43 per cent, were alive and apparently cancer-free at the end of the three-year period. Of 35 patients treated as long ago as five years, 14, or 40 per cent, were alive and apparently well. These are absolute survival rates.

For further analysis by stages of the disease, reference must be made to the original paper.

M. L. CONNELLY, M.D.

Panhysterectomy versus Irradiation for Early Cancer of the Uterine Cervix. Howard W. Jones, Jr., and Georgeanna E. Seegar Jones. *J. A. M. A.* 122: 930-932, July 31, 1943.

The authors compare the results of panhysterectomy in a carefully selected group of 36 cases of early carcinoma of the cervix with those in 704 unselected cases of all stages treated by irradiation. They found that, despite the careful selection, a five-year cure rate of only 41 per cent was obtained in the surgically treated group, which did not compare at all favorably with the rate of 57 per cent obtained in a similar, though generally less favorable, group treated by irradiation.

Although it is the opinion of many gynecologists and surgeons that operation is a satisfactory method of therapy for very early cervical carcinoma, the authors conclude that irradiation is the treatment of choice.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (R. H. M.)

Further Experience in the Management and Treatment of Carcinoma of the Fundus of the Uterus, with Five-Year End Results in 75 Patients. Lewis C. Selifey, Wm. J. Thudium, and David M. Farrell. *Am. J. Obst. & Gynec.* 46: 786-802, December 1943.

A consecutive series of 127 patients having carcinoma of the uterine fundus, seen between 1921 and 1942, were studied with respect to diagnosis and treatment. Only 20.5 per cent of the patients were below the age of fifty; 78.7 per cent had definitely passed the menopause; of the others, 7, over fifty years of age, gave a history of "irregular periods" which were evidently intermittent episodes of bleeding of organic and/or functional origin.

Irregular bleeding was the most frequent symptom, taking the form of menorrhagia and/or metrorrhagia in the premenopausal group of patients and of "spotting" in those past the menopause. The average duration of symptoms prior to diagnosis was eight to nine months in the premenopausal and twelve to thirteen months in the postmenopausal patients.

The authors consider curettage important for the diagnosis, and more and more are accompanying this with biopsy of the cervix and cervical canal. With patients of forty and over in whom there is a possibility of fundal carcinoma, especially if the gross appearance of the curetted material is suspicious, and providing the case is suitable on general principles for irradiation therapy, they insert radium (50 or 100 mg.) in the uterine cavity while waiting for a four-hour report on the curettings and, if necessary, on the biopsy material. If the condition proves to be benign, the case is treated accordingly. If a fundal carcinoma is present, adequate dosage is provided, followed by panhysterectomy with bilateral salpingo-oophorectomy in eight to ten weeks, assuming that the patient is a reasonably satisfactory risk. Otherwise radium therapy alone or associated with external irradiation is employed. If the uterine enlargement is particularly marked or irregular, if submucous tumors or accompanying adnexal lesions are present, or if the cervix is manifestly abnormal, immediate panhysterectomy and bilateral salpingo-oophorectomy is the procedure of choice. If, however,

supravaginal hysterectomy appears for some reason to be indicated, the cervix, if abnormal, is treated first by canterly or endothermic resection, together with curettage. The entire question is one of individualization rather than standardization of treatment.

In this series, 114 patients were suspected of having carcinoma of the fundus, and preliminary curettage confirmed the diagnosis in 106. Thirteen patients were not suspected of fundal carcinoma. Diagnostic curettage was performed in 5 of these, all in the postmenopausal group, and in all led to discovery of cancer and appropriate therapy.

There were associated fibromyomata in 37.8 per cent of the group who underwent operation. Previous operative procedures of a pelvic nature had been done in 30.7 per cent of the series.

The authors have extended more and more their use of surgery with preliminary radium application, while irradiation alone has been used less frequently. Postoperative x-ray therapy in patients who have been operated upon after preliminary radium irradiation is given only when there is evidence of extension of the disease outside the uterus and in cases of recurrence.

The results of treatment with surgery alone and with surgery and irradiation are presented at length. Twenty-six patients received the combined treatment prior to Sept. 1, 1937, showing a five-year salvage of 38.4 per cent, or 42.9 per cent if only those patients in whom hysterectomy was done are considered. Of 24 patients treated by surgery and irradiation between 1937 and 1942, 23 are alive one to four years (4 for four years and 5 for three years).

Summing up their results in all 75 cases seen between 1921 and 1937 the authors give the following data:

- Alive 5 to 18 years: 14 (18.6 per cent)
- Corrected for non-carcinoma deaths, 5 to 15 years: 25 (33.3 per cent)
- Five-year salvage, including carcinoma deaths, 5 to 8 years: 29 (38.6 per cent)

As to the relationship of grade of malignancy to treatment, no unalterable conclusion is reached. Low-grade lesions appear to respond equally well to irradiation and surgery, but it seems that the survival rate in intermediate and high-grade lesions is materially improved when irradiation has been a factor in the treatment, either singly or in combination with surgery. Prognosis based on the grade of malignancy alone is uncertain; it is only one of various factors to be considered.

STEPHEN N. TAGER, M.D.

Treatment of Carcinoma of the Prostate. E. W. Riehes, I. G. Williams, and A. Haddow. *Brit. J. Radiol.* 16: 187-198, July 1943.

This discussion of prostatic carcinoma was opened by Riehes, who considered the surgical aspects. He stated that about 20 per cent of enlarged prostates are carcinomatous. Two types of cancer are found, the scirrhus type, which arises in a normal gland, and the adenomatous type, which is frequently associated with a preceding hypertrophy. The average age is 66. The prognosis is better in the older patients.

The symptoms in the order of frequency are: frequency, dysuria, acute retention, hematuria, backache, loss of weight, and pain on sitting. Backache and pain on sitting usually suggest metastasis and are ominous signs.

The diagnosis depends on the finding of a hard and enlarged gland on rectal examination. It is easy in the advanced case, but may be impossible in the early case, until a specimen may be obtained by endoscopy.

An x-ray examination should be made of the lumbar spine and pelvis for metastasis. Lymph node metastases are found in 77 per cent of the cases; metastases in the viscera in 34 per cent, and in the bones in 28 per cent.

Complete cures are rare. Twenty-four cases treated by suprapubic cystostomy alone showed an average survival of nine months. Fifty-one patients treated by endoscopic resection survived an average of seventeen months without irradiation and twenty months with irradiation. The irradiated patients were more comfortable. Sixteen patients treated by prostatectomy survived an average of twenty-one months without radiotherapy and forty-two months with irradiation. Only 2 patients were treated with radium alone. They showed an average survival of 6 months.

Williams, continuing the discussion from the radiotherapist's point of view, stated that so far no case of primary carcinoma of the prostate has been cured by radiation alone. The longest survival with x-ray therapy alone in his series of cases was thirty-nine months, with surgery alone sixty months. The average survival with irradiation alone was 9.5 months (when no metastases were present); with prostatectomy alone 10.5 months; with prostatectomy and x-rays 28 months. When metastases were present the average survival under roentgen irradiation alone was 7.9 months. The average survival with radium implantation was 5.2 months.

While irradiation cannot be relied upon to relieve obstructive symptoms, there is sometimes relief out of proportion to the reduction in the size of the prostate. Irradiation of metastases usually gives surprising symptomatic relief, even greater than from drugs.

One reason for the poor results is that the disease is advanced when the diagnosis is made; 22 per cent of the cases are beyond treatment when first seen.

Haddow concluded the discussion, reviewing the work of Cutman and his associates on the relation of serum acid phosphatase and the diagnosis and course of prostatic carcinoma and of Higgins and his associates on the effect of castration. He reviews briefly the history of the use of castration and advises caution for the present in interpreting the results.

SYDNEY J. HAWLEY, M.D.

Torsion of the Spermatic Cord with Unsuspected Testicular Tumor. John H. Mohardt. Illinois M. J. 84: 389-393, December 1943.

Torsion of the spermatic cord is relatively common and is often mis-diagnosed as acute epididymitis, orchitis, or strangulated hernia. Torsion usually occurs in the 20- to 30-year age group. Onset of pain is sudden and soon followed by swelling, with the testicular mass palpable high in the scrotum and the epididymis rotated anteriorly or laterally. Surgical exploration for reduction of the torsion and, if necessary, orchiectomy for gangrene are the preferred methods of treatment.

The author's patient, 26 years old, suddenly experienced excruciating pain in the right testicle, when reaching for a distant object while in a twisted position. After conservative treatment for ten days with no relief, needle aspiration yielded 10 c.c. of clotted blood,

and the diagnosis was changed from acute orchitis to torsion of the spermatic cord with necrosis. Surgical exploration revealed the expected findings but microscopic examination of sections from the removed testicle showed an unsuspected embryonal carcinoma in its center. Radiation therapy was given, 2,500 r being administered in 10 fractions to the anterior right pelvis and right scrotum and a similar dose posteriorly, through portals 20 X 20 cm. The factors were 800 kv.; 10 ma.; 1.0 mm. Pb, 1.56 mm. Sn, 2.62 mm. Cu, 3.0 mm. Al filtration; 70 cm. F.S.D. At the time of the report, two years after treatment, repeated Friedman tests showed no evidence of recurrence and chest films remained negative.

A brief discussion is included concerning the classification of testicular tumors, the greater radiosensitivity of seminoma over teratoma, the necessity of postoperative irradiation in either case, and the value of the Friedman test in differential diagnosis and in determination of metastatic growth.

LESTER M. J. FREEDMAN, M.D.

Retroperitoneal Tumours in Children. Frederick Pileher. Canad. M. A. J. 48: 505-510, June 1943.

Wilms' tumors (embryomas of the kidney) account for the greatest number of retroperitoneal neoplasms in childhood, and the greater part of this paper is devoted to their consideration.

Embryomas are probably of congenital origin and are chiefly unilateral, although bilateral cases have been reported. The tumor is usually large, well encapsulated, and destroys the kidney by pressure. Hemorrhagic, cystic, or necrotic areas may be found, although the mass is usually solid. Metastasis probably occurs most frequently by invasion of the renal vein.

The most common first symptom is an abdominal mass, usually discovered accidentally. Pain, loss of weight, anemia and pressure symptoms, as constipation, edema and dyspnea, are evidence of far advanced disease. Gross hematuria occurs in about 15 per cent of cases and is a bad prognostic sign.

Retrograde or intravenous pycnography is the most valuable aid to diagnosis, as it will establish the presence of a normal kidney on the other side, which is important before proceeding with operation. After a short but thorough preliminary examination and preoperative preparation, immediate removal is advisable. The few weeks required for preoperative radiotherapy may be enough to permit metastasis. Following operation, preferably transperitoneally (Cabot's incision), postoperative radiotherapy may be considered.

Second in frequency among childhood retroperitoneal tumors is neuroblastoma. This is a malignant tumor most commonly arising in the adrenal medulla, although it may arise in sympathetic nerve tissue elsewhere. Differentiation from Wilms' tumor may be difficult or impossible; the exact location and nature of the abdominal mass may be determined only at operation.

M. L. CONNELLY, M. D.

Cancer Associated with Acanthosis Nigricans: Review of the Literature and Report of a Case of Acanthosis Nigricans with Cancer of the Breast. Helen O. Curth. Arch. Surg. 47: 517-552, December 1943.

Acanthosis nigricans is a benign skin disease characterized by an exaggeration of the cutaneous folds and

a brown or black discoloration. The axilla is the most common site of involvement. The palms and soles may show hyperkeratoses, and papillomas, pigmented spots, or warty changes may accompany the typical cutaneous manifestations. The disease is of two types: the one, incorrectly termed malignant, is associated with cancer elsewhere, usually in an internal organ; the other, not so associated, is termed benign. Of 395 cases reported in the literature, 196 were of the malignant and 199 of the benign type, and the other 3 were not classified. Macroscopic and microscopic features of the two types are identical, but the high coincidence of the disease with cancer can hardly be accidental. Sometimes partial regression of the acanthosis nigricans is observed following an attempt to remove the cancer, and recurrence of the acanthosis with recurrence of the cancer has been observed.

The case of a woman with a cancer of the breast and a fibromyoma of the uterus accompanied by acanthosis nigricans is reported. The acanthosis regressed following a radical mastectomy (November 1938), but began to reappear in about four months, although no overt evidence of recurrence of the cancer was observed. The areas principally involved by the acanthosis nigricans were given "six treatments with filtered roentgen rays" without effect [no data as to dose or technique]. The patient died in June 1940. At necropsy cancer metastases were found in the liver, the left adrenal, and the left kidney.

The incidence of acanthosis nigricans is low, but it has been reported from all parts of the world and in all races. Sex distribution is about equal, and the average age is 40 3/4 years. In those cases associated with cancer, the cancer originated in the stomach in about two-thirds, and in 80 to 90 per cent the cancer was intra-abdominal. Adenocarcinoma was the most frequent type, but a few others were noted, including an occasional sarcoma. No proof that these cancers were epidermal in origin has been adduced, although the idea has been proposed. All of the neoplasms associated with acanthosis nigricans were highly malignant.

The cause of acanthosis nigricans is not clear. Toxins affecting the sympathetic nervous system and adrenal damage have been mentioned. Although the condition occasionally is associated with diseases other than cancer, no close relationship has been demonstrated. Puberty seems to activate the condition in some instances, especially the non-malignant cases. A familial history has sometimes been elicited; this would account for the benign cases, in which the patient may not have lived long enough for the development of cancer which might otherwise be anticipated. It would also account for the fact that there is no consistent chronologic relationship between the development of acanthosis nigricans and cancer in the individual. The concept of a genetic relationship seems best to account for the observed facts. A very full bibliography accompanies this article.

LEWIS G. JACOBS, M.D.

Surgical Treatment of Malignant Lymphoma. Edward A. Gall. *Ann. Surg.* 118: 1064-1070, December 1943.

Forty-eight cases of malignant lymphoma of all types, sufficiently localized to permit radical excision, are presented. The question of radical excision of these localized tumors *versus* irradiation therapy is discussed and the conclusion is drawn that the life ex-

pectancy is greater with surgery than with irradiation alone. If the surgeon is not confident that he has removed all foci of involvement, then irradiation is indicated. Preoperative irradiation is advised only to shrink a bulky tumor in order to make the surgical procedure less difficult. In 21 of the series here recorded postoperative irradiation was done, the dose varying from 600 to 1,800 r, but the author is unable to assess the value of this procedure.

There were 23 known deaths in this series of cases, though not all were due to lymphoma. Nineteen patients were alive at the time of the report, and 18 of these had been symptom-free for three or more years. The remaining 6 patients were unaccounted for, though 3 of them had been under observation after operation 2.6, 3.5, and 8 years, respectively. Recurrences were observed in 23 patients—at an average of 2.2 years after surgery.

Exclusive of the two patients who disappeared immediately after discharge from the hospital, the average postoperative survival period for all cases was 5.2 years and the over-all total duration from the date of onset was 6.9 years. These figures are, respectively, two times and almost three times the levels of similar figures obtained from identical cases treated by other means.

G. A. CREEL, M.D.

Acute Lymphatic Leukemia in Childhood. Dorothy Falkenstein and Willis M. Fowler. *Am. J. Dis. Child.* 65: 445-451, March 1943.

Acute lymphatic leukemia is not infrequently encountered in childhood and presents little difficulty in differential diagnosis when the typical clinical and hematologic features are present. In many instances, however, atypical manifestations cloud the picture and the diagnosis becomes more difficult. This is particularly true when the total leukocyte count is not significantly elevated and the differential formula does not present the usual preponderance of immature cells. It is now recognized that these so-called "aleukemic" or "subleukemic" forms constitute a considerable proportion of the total number of cases. In order to compare the incidence, course, and manifestations of the aleukemic and of the more typical variety with an elevated leukocyte count, the authors reviewed 61 cases of acute lymphatic leukemia in patients under sixteen years of age.

The total leukocyte counts at the time of admission to the hospital ranged from 1,900 to 1,000,000 per cubic millimeter. Patients with a leukocyte count of 12,000 or less were considered to be in an aleukemic stage. On the basis of this figure, 32 patients were in the leukemic and 27 in the aleukemic phase at the time of admission to the hospital. One patient died before a leukocyte count was done; on a second patient only a blood smear was obtained before death. Three of the 27 patients admitted to the hospital in the aleukemic phase subsequently changed to the leukemic stage, and 4 of the 32 patients admitted in the leukemic stage later had an aleukemic phase. Of the 26 patients less than six years of age, 17 were leukemic and 8 were aleukemic; the remaining patient was one of the 2 for whom the type was not determined.

In respect to onset, course, and symptoms, there are no essential differences between patients with an elevated leukocyte count and those with a normal or low total leukocyte count. Fatigue and malaise were among the entrance complaints of 17 of the patients

with a high leukocyte count and of 9 of those in an aleukemic stage. Pallor and loss of weight were common in both forms. Enlargement of the nodes was a more prominent feature of those cases in which the circulating lymphocytes were increased. The nodes were discrete and movable and as a rule were not tender and did not suppurate. Enlargement of the spleen was observed in 47 children and of the liver in 39. Both were more common in patients with an increased leukocyte count.

Difficult breathing and cough were noted in 15 patients prior to admission, and in 11 of these a leukemic blood picture was present. On roentgen examination of the chest, a widened mediastinum due to enlarged mediastinal nodes was found in 17 cases. In one patient, a cough produced by mediastinal obstruction was a particularly distressing feature. The cough was dry and rasping and was made worse by recumbency. The superficial veins of the anterior thoracic wall and neck were prominent, and examination revealed signs of pleural effusion on the left. Roentgen therapy to the mediastinum resulted in subsidence of the dyspnea and regression in the size of the mediastinal mass, and, although death occurred in three months, there was no recurrence of the cough or dyspnea after therapy.

In 30 of the cases, the onset of the leukemia followed closely an acute infectious process of some type but, as acute infections of various types are common in children of this age group, the association may have been purely coincidental. The leukemia may have preceded the infection and so have lowered the resistance of the child that he was particularly susceptible to an infectious process. It is also possible that an unrecognized leukemia may have been present and the superimposed infection may have aggravated the symptoms to the point that they became apparent.

Hemorrhage of some degree was observed in 30 of the patients prior to admission to the hospital and purpura in 17 patients. A far greater number displayed hemorrhagic manifestations later in the disease.

Pains referable to the bones or joints were recorded in 19 of the 61 cases, being somewhat more frequent in the aleukemic type. Roentgen evidence of bone involvement may be found in certain cases, although there is no correlation between this and the presence of pain, nor are the roentgen features of a type which is pathognomonic of leukemia. Changes are more frequently found in the bones containing hemopoietic marrow and may be confined to the periosteum. The lesions may be either osteoclastic or osteosclerotic; the most frequent feature is a narrow transverse zone of lessened density proximal to the metaphysis of a long bone. In the skull and pelvis the most common lesion is a generalized osteoporosis which is irregular and mottled in appearance.

The course of the leukemia was acute and rapidly progressive except in one patient who lived for fourteen months after the onset of symptoms. The average duration of life from the first symptoms until death in children for whom the time of death was known was eighteen weeks. This was the same for the leukemic and the aleukemic patients. In 9 of the 18 patients who died under observation in the hospital death was due to complications or superimposed infections. One child died of respiratory failure preceded by extreme cyanosis from mediastinal obstruction; four succumbed to lobar pneumonia, and one to otitis media.

Six children died as a result of profuse uncontrollable hemorrhage and one with a convulsion resulting from cerebral hemorrhage. Three died from progressive weakness and anemia. Two patients were moribund on admission.

High-voltage roentgen therapy was tried for 15 children with enlarged mediastinal nodes and for children in whom pressure manifestations from enlarged nodes were present. Such therapy relieved the pressure symptoms and made the patient more comfortable. Roentgen therapy to the liver, spleen, or nodes in the absence of pressure symptoms did not improve the patient's condition nor prolong life. In fact, in some instances it apparently made the condition worse by greatly increasing the already elevated metabolic rate and hastened the fatal outcome. Transfusions were administered to 34 patients and were found to be of slight palliative benefit only.

NON-NEOPLASTIC DISEASE

Roentgen-Ray Treatment of Acute Inflammatory Conditions. George E. Pfahler. *Pennsylvania M. J.* 47: 225-228, December 1943.

This paper is a general review of irradiation in acute inflammatory conditions, based on reports in the literature. The author believes that Freund in 1897 was the pioneer in this field. At first, only chronic inflammations, such as tuberculous adenitis, keloids, osteomyelitis, ringworm of the scalp, and acne vulgaris were treated. Later, acute inflammations, such as erysipelas, boils, carbuncles, gas gangrene, acute otitis media, acute mastoiditis, and even acute general peritonitis, tonsillitis and tonsillar abscesses, were found to respond favorably. It is believed from the results of experimental research and from clinical observation that the improvement shown following x-ray therapy is due to the destruction of leukocytes and the consequent liberation of antibodies.

The general principles of technic should be kept in mind rather than any fixed formula applied by some author for a particular purpose. "The more acute the disease, the larger the area treated, and the younger the patient, the smaller should be the dose; and if repetition is necessary the shorter should be the interval." The quality of the radiation should be such that 30 to 50 per cent will reach the affected area. In chronic inflammations, one must be cautious about repetition, and the total dosage must always be considered. Failure to keep account of the total dose in any given length of time has often brought roentgen therapy into bad repute.

In cases of gas gangrene the author quotes Kelly as saying that patients treated early will respond favorably in most cases.

Boils and carbuncles can be checked if treated early or their termination can be hastened.

In erysipelas, irradiation may be considered almost as a specific in adults, but children do not respond well.

Both acute and chronic thrombophlebitis have been treated with good results. In the acute cases 100 to 150 r is given, using 140 to 160 kv. with 3.0 mm. Al in superficial cases and 0.3 mm. Cu plus 1.0 mm. Al in deeper lying inflammations. One treatment may be sufficient.

In general the lymphoid tissue in tonsillitis and pharyngitis is very radiosensitive. The dosage should be between 50 and 100 r per sitting.

In postoperative parotitis x-ray therapy brings about a marked reduction in the death rate. In some cases only one treatment is necessary and good results have been obtained even when suppuration supervened.

For acute mastoiditis the author quotes Shillinger as advocating that x-ray be used as a prophylactic agent in all simple suppurations of the middle ear. The subjective symptoms of mastoiditis are enumerated and the syndrome of favorable action after the use of x-ray therapy is described. JOSEPH T. DANZER, M.D.

An Evaluation of Roentgen Therapy in Disease of the Sinuses. C. L. Crang. *Canad. M. A. J.* 49: 117-119, August 1943.

Irradiation is generally held to be of benefit in sinus disease because it destroys lymphocytes and releases antibodies and enzymes, producing a process similar to the normal response to infection. It is only in cases with marked lymphocytic infiltration in the mucosa, therefore, that roentgen therapy is indicated. In the average case of acute sinusitis, which responds well to ordinary measures for promoting drainage, irradiation will frequently relieve the headache and hasten recovery. In acute fulminating types, if treatment is to be of any value it must be given early in the disease before invasion of the bone. The best results are obtained in the subacute types of infection. Chronic sinusitis with hyperplastic changes responds well if there is no sclerosis of the bony wall. Irradiation is of little value in chronic atrophic sinusitis or sinusitis of allergic origin.

The author uses 135 kv., 0.25 mm. Cu and 1.0 mm. Al filter, 40 cm. distance, giving 100 r in air twice a week for four or five treatments, through an anterior portal about 5 inches in diameter. For disease of the posterior ethmoids or sphenoidal sinuses he prefers two anterior oblique fields, which, by overlapping, permit a greater depth dose. He reports a series of 57 cases, with excellent results in 46 per cent, fair results in 14 per cent, and poor results in 40 per cent.

It is pointed out that favorable results will be obtained only if cases are studied in co-operation with a rhinologist and are carefully selected for treatment.

M. L. CONNELLY, M.D.

Treatment of Asthma with the Roentgen Ray. I. I. Kaplan and Sidney Rubinfeld. *Am. J. Roentgenol.* 50: 791-796, December 1943.

The results of roentgen irradiation in 66 patients with asthma are analyzed and discussed. Treatment consisted in the administration of unit doses of 100 to 150 r measured in air, twice or three times weekly until a dose of 600 r was given (200 kv., 5-20 ma., 0.5 mm. Cu plus 1.0 mm. Al). Usually the thorax was irradiated with an open field at 40 to 50 cm. distance, alternating anteriorly and posteriorly until each side received 600 r. The patients had all been carefully studied clinically, sensitivities had been determined, and corrective measures introduced. The cases had been referred to the radiation therapy clinic because of failure with other methods of treatment.

Of 56 patients receiving irradiation over the thorax, 36 were relieved of their anxious spasms at the end of one series of 600 r. Eight patients needed 700-800 r before they exhibited relief. In 5 cases irradiation was given over the cervical sympathetic chain, and these exhibited little or no response. Treatment

over the spleen in 4 cases produced complete relief from the paroxysms. Recurrence of attacks is, unfortunately, the rule rather than the exception. In general, the longer and more severe the illness, the more favorable the response to irradiation. Aggravation of symptoms often preceded amelioration.

L. W. PAUL, M.D.

Radiation Therapy of Acute Subdeltoid Bursitis. Arthur A. Brewer and Oscar C. Zink. *J. A. M. A.* 122: 800-801, July 17, 1943.

The authors describe the syndrome accompanying acute subdeltoid bursitis as being rather typical. There is usually rather sudden onset of severe pain in the shoulder with no history of significant trauma. Exquisite point tenderness may be elicited over the area of the subdeltoid bursa, with pain radiating down the arm. There is limitation of motion and muscle spasm. The patient is apprehensive about any attempts to move the arm, and there is no doubt that he is in severe pain. The subacute and chronic types present similar but less pronounced symptoms.

In typical cases there is roentgenographically demonstrable calcium deposition just lateral to the greater tubercle of the humerus, described by Codman as calcification within the supraspinatus tendon (*Boston M. & S. J.* 154: 613, May 31, 1906).

For therapy the physical factors employed were 200 kv., 18 ma., 0.5 mm. copper and 1.0 mm. aluminum filter, 50 cm. target-skin distance, and 10 X 15 cm. port over the anterolateral aspect of the involved shoulder. Usually a single dose of 300 r was given. In 11 of 14 cases, this treatment was followed by aggravation of symptoms for as long as twenty-four hours, after which spectacular relief permitted the resumption of normal activity within forty-eight hours. If relief does not occur in forty-eight hours, the authors suggest that operative removal of the bursa be considered.

The results in treatment of the chronic type have not been nearly so spectacular, only about 30 per cent of the patients treated obtaining any degree of relief.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (R. H. M.)

Treatment of Plantar Warts. J. E. Gendreau and Origène Dufresne. *Canad. M. A. J.* 49: 35-37, July 1943.

Roentgen therapy is considered the method of choice for plantar warts since it curbs mitosis of the hyperplastic cells and makes the horny hyperkeratotic layer exfoliate. Various techniques are discussed. The authors use a single moderately intensive dose of filtered radiation, which is repeated after a month if necessary. Of 38 cases thus treated 31 (81.5 per cent) were cured. In 3 cases contact therapy was used, with a single dose of 700 to 900 r (2 cm. distance, 1 mm. Al filter), and good results were obtained in all.

If the lesions are multiple, they should be separately treated, starting with the mother wart; if they are inflamed, treatment should be postponed a week or two; if they do not disappear following a single intensive dose or two doses at an interval of a month, treatment should be discontinued because of the danger of a radiodermatitis.

When plantar warts do not respond to roentgen therapy, negative electrolysis, diathermocoagulation, electrodesiccation, fulguration, or eryotherapy is used.

Diathermocoagulation seems to be the most reliable and convenient of these measures.

M. L. CONNELLY, M.D.

Some Data Concerning the Use of X-Ray Beams in Direct (Cross Firing) Opposition. C. W. Wilson. *Brit. J. Radiol.* 16: 247-249, August 1943.

By means of graphs the ratio of the center dose to the surface dose (with back-scatter) is given for various field sizes, various skin-target distances, and qualities.

SYDNEY J. HAWLEY, M.D.

EFFECTS OF RADIATION

Fractures of the Rib Cage Following Interstitial Radium Therapy for Cancer of the Breast. Hoke Wammock and Robert K. Arbuckle. *Am. J. Roentgenol.* 50: 609-615, November 1943.

The authors' experience has demonstrated that bone is not so radioresistant as was formerly thought and that permanent damage can result from a therapeutic dose applied to a nearby neoplasm. They present a group of 10 patients in whom fractures of the ribs followed treatment by interstitial radium element needles for cancer of the breast. These patients had remained free of clinical evidence of cancer for periods ranging from four to nine years.

The method used consists of the application of platinum needles with a wall thickness of 0.8 mm., some 44 mm. long, containing 2 mg. of radium, and the remainder 60 mm. long, containing 3 mg. of radium. The irradiated area extends from the sternum to the posterior axillary line and from the supraclavicular fossa to the costal margin. Needles are placed so that they lie parallel to each other and 1.5 cm. apart, on a plane just beneath the tumor, either just above or just below the fascia. Two rows are generally used, the ends of the needles overlapping slightly. The average amount of radiation delivered is 22,000 mg. hr. Two patients received roentgen therapy prior to the interstitial application of radium.

Fractures of the ribs were noted on chest roentgenograms which were made at intervals for detection of pulmonary metastases. There was no history of trauma and no evidence of local or metastatic cancer. Some patients gave no symptoms referable to the rib cage. In others, symptoms were insignificant. The number of ribs fractured varied from one to five. In most instances the fractures appeared in less than two years.

The authors conclude that these rib changes are the result of a non-neoplastic post-gamma irradiation effect, brought about by an interference with the blood supply of the ribs. It is therefore evident that adult bone is not resistant to therapeutic irradiation directed to a nearby neoplasm.

CLARENCE E. WEAVER, M.D.

Spontaneous Rib Fractures Following Irradiation for Cancer of the Breast. Asa B. Friedmann. *Am. J. Roentgenol.* 50: 797-800, December 1943.

A case is reported in which, following heavy irradiation for an adenocarcinoma of the breast with axillary

and supraclavicular and local skin metastases, there developed as a sequel to the irradiation late degenerative changes in the brachial plexus, ribs, and skin, with benign pathological fractures of six ribs and motor and sensory disturbances of the arm. The disease remained arrested over a seven-year period. The bone changes following heavy radiation are those of progressive fibrosclerosis with a resultant closing of the circulation in the haversian systems and the periosteal vessels. The bones become devitalized and brittle and fracture easily. Because of the bone death the fractures do not heal but they also are insensitive.

L. W. PAUL, M.D.

Some of the Effects of Roentgen Irradiation on the Cardiovascular System. John E. Leach. *Am. J. Roentgenol.* 50: 616-626, November 1943.

In experiments on adult rats it was found that at least 10,000 r delivered in a single dose was necessary to produce microscopic evidence of myocardial damage. The pericardium and endocardium of these animals were intact. In another group of animals followed for over a year and given single doses up to 7,500 r through a single portal, no late changes such as muscular atrophy or myocardial fibrosis were found.

Eighty-five patients undergoing radiation therapy for cancer were observed over a four-year period. Some of these had treatment over various parts of the body not including the thorax, another group had treatment to various regions including the thorax, and a third group received treatment solely to the thorax. In general, there was a drop in the blood pressure at the height of the irradiation reaction. Factors chiefly responsible were thought to be insufficient nourishment with weight loss, anemia, tumor infection, toxemia, fever, and tumor cachexia rather than the depressing effect of the roentgen rays themselves. Ten patients showed different arrhythmias of all types. These, with one exception, were present before roentgen therapy was instituted and followed the same course seen in patients not subjected to irradiation. There was no conclusive evidence that chronic pericarditis and pleuropericardial adhesions were the result of irradiation. In 4 patients a rather marked carotid sinus syndrome developed during the course of roentgen therapy. This was probably due to the pressure of infected metastatic nodes on the carotid sinus rather than any specific action of the roentgen rays. The venous pressure may be elevated and the circulation time may be prolonged. This may be due to angulation of the left innominate vein and superior vena cava associated with irradiation pleuropulmonitis in the upper right lung field. Changes in the electrocardiogram may result from changes in the position of the heart in the chest. This change in position may be quite marked when the left lung is irradiated. It is probable that electrocardiographic alterations are due to changes in the direction of the electrical pathways and are not the result of myocardial disease.

The author concludes that he has found no evidence that the heart has been damaged by roentgen therapy as it is used today in the treatment of cancer.

CLARENCE E. WEAVER, M.D.

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Correlation of the X-Ray Diagnosis with the Operative Findings in Small-Intestinal Obstruction

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WHILE ADEQUATE recognition is given to the early radiological investigation of lesions in the stomach, duodenum, and colon, the value of this procedure in small-intestinal obstruction is overlooked. This is due probably to the stress that has been placed upon the former at the expense of the latter. So important is the x-ray in the early diagnosis of intestinal obstruction that emphasis should be placed repeatedly upon its use.

In the stomach and colon the gas is more or less free and its distribution is demonstrable as a shadow on the film; in the small bowel the gas is distributed and intimately mixed with the bowel contents and cannot normally be shown by radiologic study. Its demonstration is indicative of bowel interference and is of pathological significance. It presents a shadow early in obstructive lesions of the small bowel which is of great diagnostic value.

Although gaseous shadows in the small bowel have been known for over thirty years to be of some importance as an indication of disturbed motility, the profession is still not sufficiently impressed with their diagnostic value to institute an early radiological study in small bowel obstruction. Schwarz, in 1911, called attention to the gaseous shadows seen in the small bowel

in obstructive lesions and indicated their significance. He advised the use of an opaque medium as a confirmatory diagnostic agent. In 1914 Case described gas shadows in the small bowel as a diagnostic aid in obstruction. Kloiber, in 1919, was the first to state that the diagnosis of small-bowel obstruction could be made by the gaseous shadows on an x-ray negative, and that a contrast medium was not necessary for confirmation. He demonstrated that gas shadows in the small bowel were abnormal and indicative of obstruction.

The typical transverse pattern, described by Case, is not necessary for a diagnosis of small-bowel obstruction. A collection of gas in the small bowel in the adult may be considered as synonymous with obstruction. In very small children, gas may be seen in the small bowel and be of no diagnostic significance. The collection of gas after obstruction is not a late development; it is seen soon after the onset of the obstruction, usually being demonstrable without difficulty in four or five hours. The distribution of the gas in the small intestine is indicative of the probable type of lesion. In simple obstruction, it may be centrally located, with a transverse long axis; in loop obstruction, the dilated loops may assume no definite pattern, and proximal bowel distention is slow in developing. If the walls separating loops are thick, it

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

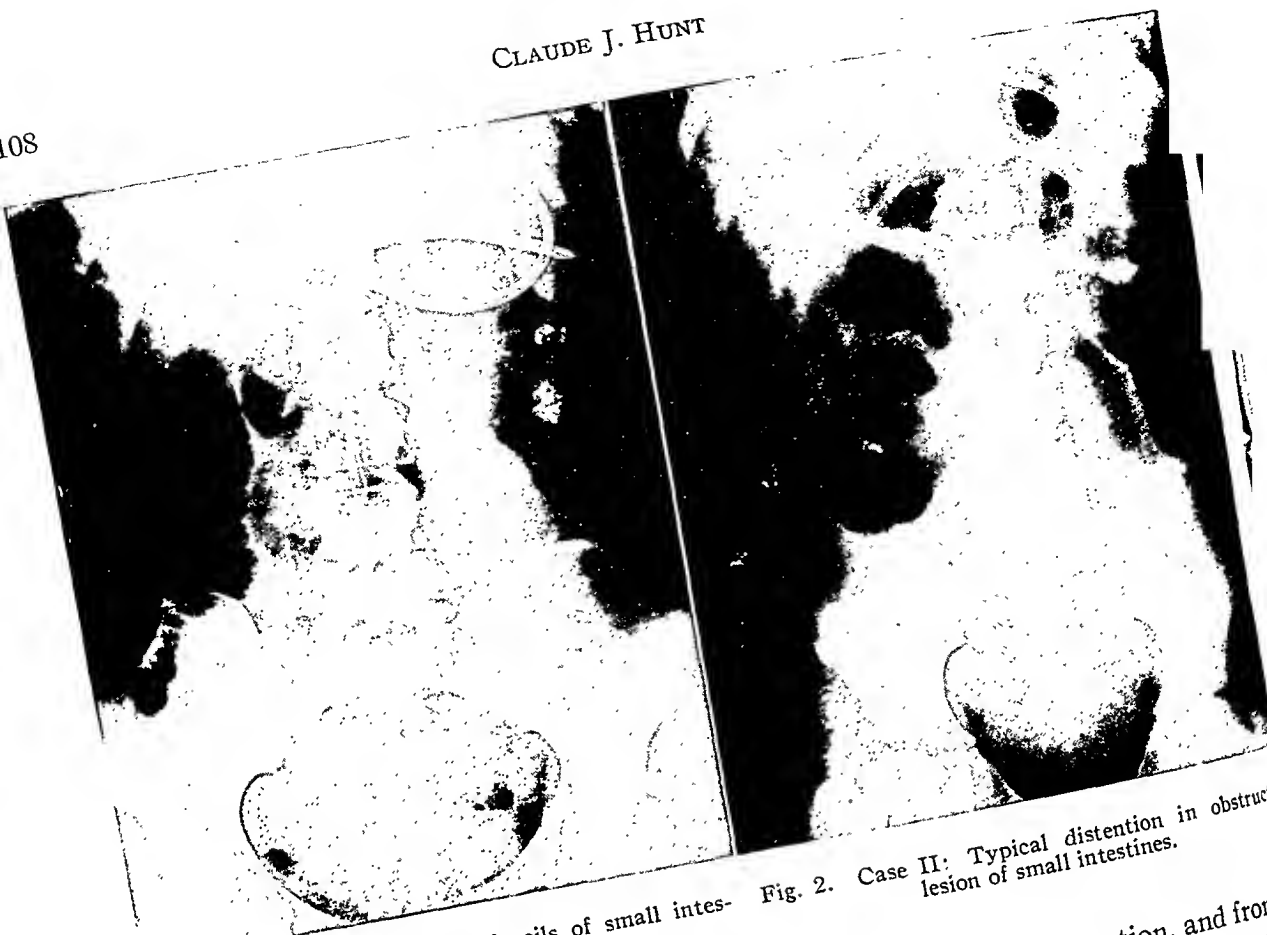


Fig. 1. Case I: Distention of coils of small intestines, indicating obstruction.

Fig. 2. Case II: Typical distention in obstructive lesion of small intestines.

signifies the presence of fluid or exudate. Collections of gas in the large intestine are quite in contrast to collections in the small bowel, in that the long axis is vertical, the bowel wall is thicker, and haustral markings are present. The step-ladder appearance of small-bowel distention indicates advanced obstruction and is associated with a variable degree of abdominal distention. The gas is present and can be demonstrated long before distention and this particular pattern develop. Thus it may be said fairly accurately that the x-ray can make an early diagnosis of small-bowel obstruction, and that it can demonstrate the distribution of gas and the location and probable nature of the obstruction.

From an abdominal roentgenogram, one can readily determine whether the distention is in the large bowel or the small bowel. If it is in the large bowel, there is usually a closed loop obstruction, the ileocecal valve preventing regurgitation into the ileum. If it is in the small bowel, the type and character of the distention depend upon

the nature of the obstruction, and from the pattern of distention the urgency of the situation becomes apparent.

In postoperative distention there may be a question as to whether a mechanical obstruction is present or a paralytic ileus the causative factor. In the former event the small intestines are obstructed, while in the latter there is distention of both the small and large bowel. A radiographic film shows the nature of the gaseous distention and distinguishes between the two conditions. If the obstruction is mechanical, the small bowel is distended and the colon is empty; in ileus, gaseous distention is present in both the small and large bowel. Repeated films may be necessary to determine the certainty of an ileus. Consideration must also be given to the presence of a so-called silent and painless abdomen as a differential point in diagnosis.

A simple adhesive band producing proximal distention of the bowel results in immediate vascular damage, and operative

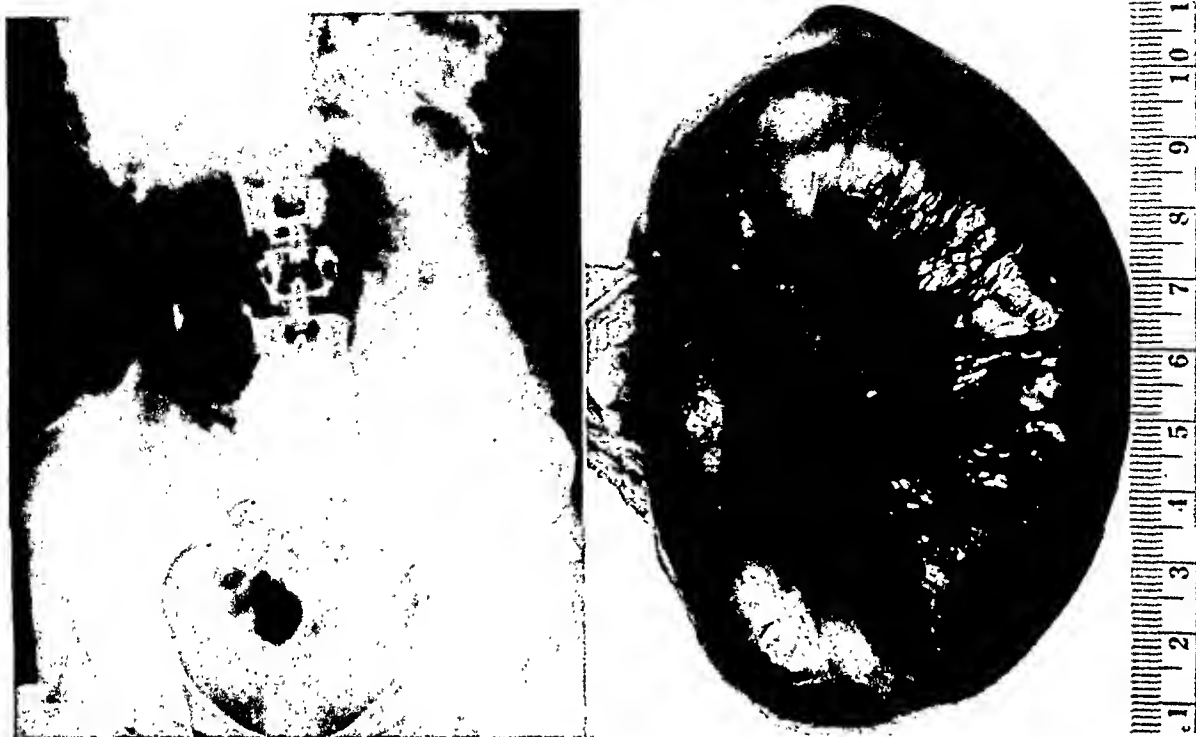


Fig. 3. Case III: Loop obstruction secondary to volvulus. Roentgenogram and operative specimen (metric rule).

may be deferred until rehabilitation of the patient can be accomplished and intestinal decompression established. A loop obstruction, volvulus or strangulation, on the other hand, demands immediate operative interference because of the danger of devitalization and bowel gangrene. With such obstruction, the bowel is not observed assuming the transverse position, but forming one or more distended loops, with no set pattern and with little or no proximal distention until the obstruction has been present for some hours. The reason for the delay in distention of the proximal bowel is not understood, but it is probably due to the associated hyperemia and edema. Wangenstein mentions the altered state of the bowel proximal to the infarcted loop as a partial explanation.

The simple adhesive obstructions are probably the most common types involving the small intestines, and their presence can be detected early by radiological study. The pattern is characteristic, and the sequelae of loss of electrolytes and of body fluids and distention are in relation to the extent and level of the obstruction.

CASE I: M. I. entered the hospital with abdominal pain, periodic in character, and with moderate distention. Little or no fluid loss from vomiting had occurred. A recent operation had been performed elsewhere for an acute appendicitis. Recovery had been uneventful, without protracted hospitalization or abdominal drainage.

Obstruction was suspected because of the nature of the complaints, the absence of symptoms indicating any other type of colic or localized inflammatory process, and the presence of an abdominal operative scar, which always adds weight to the suspicion of small-intestinal obstruction. An x-ray film (Fig. 1) revealed obstruction of the distal portion of the small bowel with only moderate proximal bowel distention. Favorable systemic and local conditions warranted immediate operation, which corroborated the x-ray diagnosis of small-bowel adhesive obstruction. The terminal ileum was constricted and angulated by a band of adhesion. Recovery was uneventful.

CASE II: A similar condition is shown in M. H., a girl of 13 years who, six weeks previously, had an appendectomy for acute appendicitis, accompanied by drainage. Abdominal pain suggestive of obstruction prompted an x-ray study of the gaseous distribution in the intestinal tract. This readily revealed a simple obstructive lesion of the terminal small bowel (Fig. 2). Again operation corroborated the x-ray diagnosis. Recovery was prompt after an adhesive obstruction 6 or 8 inches from the cecum was freed.

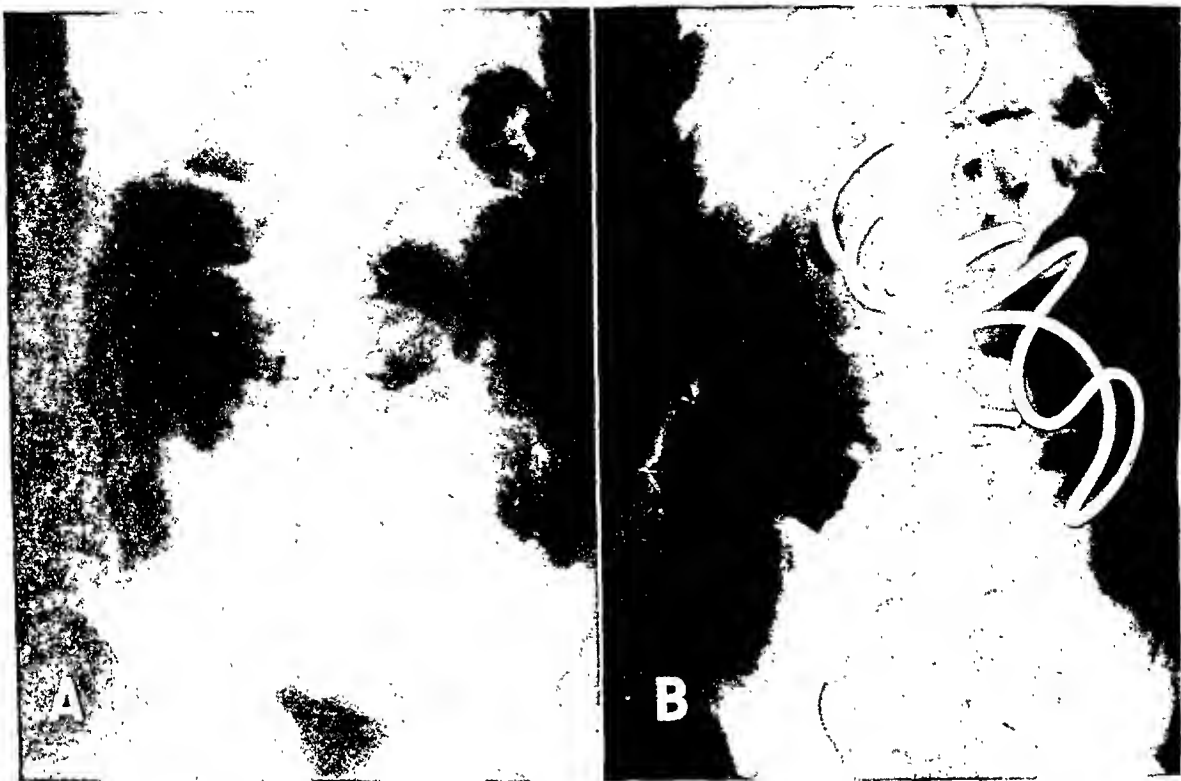


Fig. 4. Case IV: A. Distention of coils of small bowel nineteen days following operative procedure. B. Deflation of small intestines by use of a Miller-Abbott tube.

CASE III: Figure 3 shows the pattern of intestinal gas in a middle-aged woman, S. B., who had previously had a panhysterectomy for a fundal carcinoma of the uterus. The x-ray diagnosis was a loop obstruction of the small intestine, without proximal bowel distention, and immediate operation was advised. The possibility that obstruction was due to metastatic cancer was considered. At operation a loop obstruction with volvulus and gangrenous bowel, adhesive and benign in character, was found. Resection with side-to-side anastomosis was followed by a normal convalescence. The operative findings confirmed the radiological diagnosis. The resected specimen is shown in Figure 3.

Small-bowel obstructions frequently occur in association with inflammatory lesions within the abdomen and usually present the characteristic pattern of a progressive proximal bowel distention in which the viability of the bowel is not in jeopardy. In this type of obstruction it is not often necessary to interfere surgically, as the condition results from localized inflammation and edema which narrow and constrict the adherent bowel to the point of obstruction. The constriction will usually

disappear, and the bowel again become patent, if the patient can be carried along by intestinal intubation and such rehabilitation methods as administration of fluids and salines and transfusion until the inflammatory process has subsided.

Surgery is attended by great danger to the inflamed edematous bowel and may lead to extension of the infection. Intestinal decompression by the Miller-Abbott tube reduces distention and lessens the edema and hypertrophy proximal to the obstruction. With intubation and appropriate systemic measures, recovery will occur without resort to surgery. Enterostomy is not required, as a more effective decompression measure is found in intestinal intubation. Enterostomy is ineffective, since it drains only a limited segment of the bowel or a few distended loops and has many hazards.

CASE IV: This case illustrates the value of conservative decompressive measures. W. H., a 16-year-old boy, presented the picture of an acute

abdominal condition of several days' duration. The abdomen was board-like but not distended; the pulse was fast; the temperature was elevated 3 degrees; the white blood count was 20,000. The patient was dehydrated and in very unfavorable condition for immediate surgery. Since it had been several days since the onset of the acute process, and because of the poor condition of the patient, conservative measures were followed. A mass developed and subsequently a large appendiceal abscess was surgically drained. Convalescence was stormy but progressive until the 19th postoperative day, when abdominal pain, periodic and cramp-like in character, developed. Diffuse abdominal colic was followed by vomiting. Obstruction was suspected, and a film of the abdomen (Fig. 4A) showed rather extensive distention of the small bowel. A diagnosis of obstruction of the small intestines was made, due to proximity of the gut to the inflammatory process. The use of the Miller-Abbott tube (Fig. 4B), adequate fluids, saline, glucose, and blood transfusions resulted in complete recovery after a secondary abscess spontaneously drained through the operative incision. After forty days of hospitalization convalescence was complete, and the patient was discharged.

External strangulation obstruction in the nature of hernia usually requires no x-ray study, as the patient seeks medical aid early and the diagnosis is made before abdominal distention occurs. Occasionally an obscure hernia within the abdomen arouses the suspicion of intestinal obstruction and is confirmed by a radiographic film. The picture is similar to that of a simple obstruction, with the added danger of segmental bowel gangrene.

CASE V: This recent case shows the possible danger of bowel gangrene in an apparently simple obstruction. The patient, F. P., 67 years of age, gave no history of previous intestinal disorder and had undergone no abdominal surgery. The radiograph (Fig. 5) demonstrated gaseous distention of the small bowel of the simple obstructive type. Operation revealed a Richter's hernia of the small bowel into the femoral canal. The segment of bowel involved was viable and recovery was without difficulty.

In patients of advanced years in the absence of previous abdominal surgery, the possibility of a colonic lesion must be given careful consideration. This can be most effectively determined by barium enema. Such a lesion being excluded, some variety of internal hernia must be considered.



Fig. 5. Case V: Gaseous distention indicating obstruction due to a Richter's hernia.

Intussusception presents two avenues for profitable use of the x-ray. First, it is most valuable in confirming the diagnosis suspected from the passage of blood and mucus in the stools of an infant or small child who has abdominal colic and a palpable mass. Second, it is the only guide by which one may be certain of reduction by non-surgical means. Only with the aid of a thin opaque enema can complete reduction be determined. Reduction may appear to be successful when in reality a segment at the ileocecal valve may remain intussuscepted. The completeness of reduction can be determined only by use of an opaque medium which shows the entire outline of the colon and cecum.

Figure 6 (Case VI) shows an intussusception before reduction by barium enema (A) and illustrates the completeness of reduction as demonstrated by a well-visualized cecum (B). Figure 7 (Case VII) shows an intussusception of the ileum into the splenic flexure, requiring surgical reduction.

The clinical history of the obs



Fig. 6. Case VI: A. Changes in the contour and outline of the opaque column indicating intussusception. B. Intussusception completely reduced.

patient is as essential to proper interpretation of the film by the radiologist as it is to the surgeon. A co-operative exchange of information is essential and helpful to both. The radiologist must associate the clinical history and physical findings with the radiographic picture. He must therefore evaluate the symptoms and signs of small bowel obstruction. While intestinal obstruction presents few or no early physical signs, their very absence indicates that there is no localized process in any of the four quadrants of the abdomen. The colic is diffuse and periodic and differs from any other form of abdominal colic, which is usually localized in character and constant and continuous in type. Abdominal rigidity and localized tenderness are not present as in an acute inflammatory process involving the appendix or gallbladder, or a perforated duodenal ulcer. The pain comes in paroxysms, with intervals of relief. Peristalsis may be seen over the abdomen during the spasms of pain, and auscultation

may reveal the increased sound of intestinal contractions. The abdomen presents a noisy rumbling sound during these paroxysms—borborygmus.

It must be remembered, as emphasized by Wangenstein, that the passage of gas or movement of the bowels does not eliminate the possibility of obstruction. The bowel distal to the obstruction is unimpaired and may function normally, completely emptying itself of gas and feces. Wangenstein and Goehl state that good results may be obtained by an enema, and unless this is kept in mind, a false security may result from a copious passage of gas or evacuation of the bowels.

Tenderness or muscle rigidity is present with loop obstruction only when the distended loop of congested bowel is in contact with the parietal peritoneum. Vomiting is dependent upon the duration and the level of the obstruction and the degree of the distention. The very absence of early physical signs suggests the possibility of

bowel obstruction and, in a patient who has had one or more abdominal operations, should bring to the surgeon's mind the possibility of adhesive obstruction and cause him to seek the information which the radiologist can so accurately furnish.

In partial obstruction much difficulty may be experienced in making a diagnosis from the radiographic film unless intermittent complete obstruction is present. Lockwood emphasizes the advantage of an opaque medium as an aid to diagnosis. Its significance centers around the rapidity of its progress through the intestinal tract. Any retardation of the barium or the detection of a malformed loop is of great significance. Frequent films are necessary to follow the barium in its intestinal advance.

The indications for the use of the Miller-Abbott tube in small-intestinal obstruction are very definite. In our hospital the procedure of passing the tube is usually quickly accomplished by our radiologist, Dr. Ira H. Lockwood, and his associates, whose splendid co-operation we acknowledge. This we believe to be a function of the radiological department, as intestinal intubation can be done successfully only under fluoroscopic observation. The tube is indicated and extremely useful in simple adhesive obstruction with extensive proximal distention and for decompression prior to operation. It is valuable in early obstruction of a similar nature to prevent postoperative ileus and to hasten restoration to normal of an already partially distended bowel. It is not indicated as a preoperative measure in loop obstruction, in volvulus, or strangulated obstruction where the viability of the bowel is in jeopardy. It may be valuable as a postoperative decompressing agent to prevent further distention and to hasten restoration of bowel tone. Although the Miller-Abbott tube has fallen into disrepute in many sections of the country, we feel that it is beneficial and can be applied in selected cases of intestinal obstruction.

The passage of the Miller-Abbott tube



Fig. 7. Case VII: Gas-filled intestine indicating an intussusception that required surgical reduction.

into the small bowel requires patience, along with a certain amount of skill. We are under the impression that much time can be saved the patient by starting the intubation under fluoroscopic control. The procedure followed by Lockwood is as follows:

The patient is brought to the x-ray department with the necessary equipment. The tube is assembled and checked by the radiologist. If the patient is apprehensive, gags easily, or is restless, he is given sodium phenobarbital (grains 1 to 4 intravenously, depending upon his size) along with atropine (grains 1/150 to 1/75). We feel that the depressant action of the phenobarbital on the gastro-intestinal tract is much less than that usually accompanying an opiate.

The tube is inserted into the stomach through the nose and pushed down along the greater curvature in an attempt to pass it through the pylorus. If the tube does not enter the duodenum immediately, the balloon of the tube is inflated slightly and

is left in close proximity to the duodenum. Peristaltic action of the stomach will pull the tube through into the small bowel in the average case.

In patients with paralytic ileus and in moribund patients the instillation of hypertonic saline into the colon or an infusion of hypertonic saline into the vein will result in an increase in the peristaltic activity of the bowel. Only one word of caution—the reaction to the saline is sometimes violent. One must be sure that the tube is on its way down into the small bowel before the saline is administered, as perforation of the bowel may result without any means of decompression.

In our series of cases with the Miller-Abbott tube used as an adjunct in intestinal obstruction we found a definite improvement in the condition of the patients in twelve to twenty-four hours.

CONCLUSIONS

1. The x-ray should be more frequently employed by the surgeon as a diagnostic agent in suspected small-bowel obstruction.

2. A radiographic film reveals much information concerning the patency of the small-intestinal tract.

3. The probable location and nature of the obstruction can be determined by radiographic study.

4. The immediate urgency of surgery can be determined by the type of bowel distention, there being usually a different

pattern of gas distribution in the simple than in the strangulated obstruction.

5. Many features serving to distinguish between mechanical obstruction and ileus can be observed by radiographic study.

6. The value of a barium enema in the reduction of intussusception is emphasized.

7. Clinical analysis of the symptom complex should be a part of the radiologist's information in interpreting the x-ray film.

8. The indications for use of the Miller-Abbott tube are stressed and a method of passage is described. Passage of the tube is a function of the radiological department.

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The Roentgenologic Features of Mediastinal Tumors¹

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ALTHOUGH MEDIASTINAL tumors are not common, their incidence is frequent enough to warrant further investigation. Up to the present time their preoperative classification has proved difficult or impossible, but in view of the continued progress in the field of thoracic surgery, their differentiation prior to operation has become increasingly important. The present study was undertaken in an effort to determine whether any of these tumors had characteristic roentgenologic features.

During the period from 1938 through 1942, 44 cases of proved mediastinal tumor were found among approximately 60,000 chests examined at the Massachusetts General Hospital. Malignant lymphoma and metastatic involvement of the mediastinal lymph nodes were not included in this study. Heuer and Andrus (3), in a monograph covering the literature up to 1940 and including their own cases, reviewed a great variety of mediastinal tumors and discussed their diagnosis and treatment. Our group is smaller and does not include as many different types of tumor, but all of the 44 cases were proved by operation, aspiration, or autopsy. The series included 25 congenital tumors—15 "bronchiogenic" cysts (6), 7 dermoid cysts, and 3 malignant teratomata—14 tumors of neurogenic origin, 1 malignant tumor, unclassified, and 4 tumors of the thyroid, parathyroid, or thymus glands. The last 4 included 2 intrathoracic goiters, one thymic tumor, and one tumor of the parathyroids.

CONGENITAL TUMORS

Bronchiogenic Cysts (6): From the roentgenologic point of view the most important diagnostic feature of a bronchiogenic cyst is a smooth, round or ovoid

shadow arising anywhere within the mediastinum without evidence of bone erosion or calcification. Demonstration of tracheal attachment offers additional diagnostic evidence, but is not conclusive, since a substernal thyroid, an aneurysm of the innominate artery, and other masses may be attached to the trachea and may present a similar appearance. It should be remembered also that bronchiogenic cysts may grow within the lung as well as in the mediastinum.

Unless the cyst becomes infected, its discovery is usually incidental. Those cysts in our series which became infected simulated lung abscess, or empyema with a bronchial fistula, in symptomatology and somewhat in their roentgen appearance. In the group of 15 the sex distribution was about equal, 8 males and 7 females.

Dermoid Cysts (Fig. 1): All of the 7 dermoid cysts were in the anterior mediastinum. Only one was found in the upper portion; the others were located in the middle and inferior portions. As a rule, the outline of the dermoid cyst was slightly irregular as compared to the smooth, rounded outline of the bronchiogenic cyst. In size the dermoid cysts varied from 7 cm. to 17 cm. in diameter. Three showed calcification in the wall, one with actual bone formation. In one case, the cyst communicated with a bronchus and showed a fluid level, as well as what was apparently semisolid material. None showed fluid in the pleural cavity. In 2 cases, atelectasis of the adjacent lung was present.

Teratomata (Fig. 2): The 3 teratomata in the group were located in the anterior mediastinum. Two showed slight lobulation of outline; the third was smooth. All were homogeneous in density; all showed a small amount of atelectasis of the adjacent lung, and all gave evidence of fluid

¹ From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. Accepted for publication in December 1943.

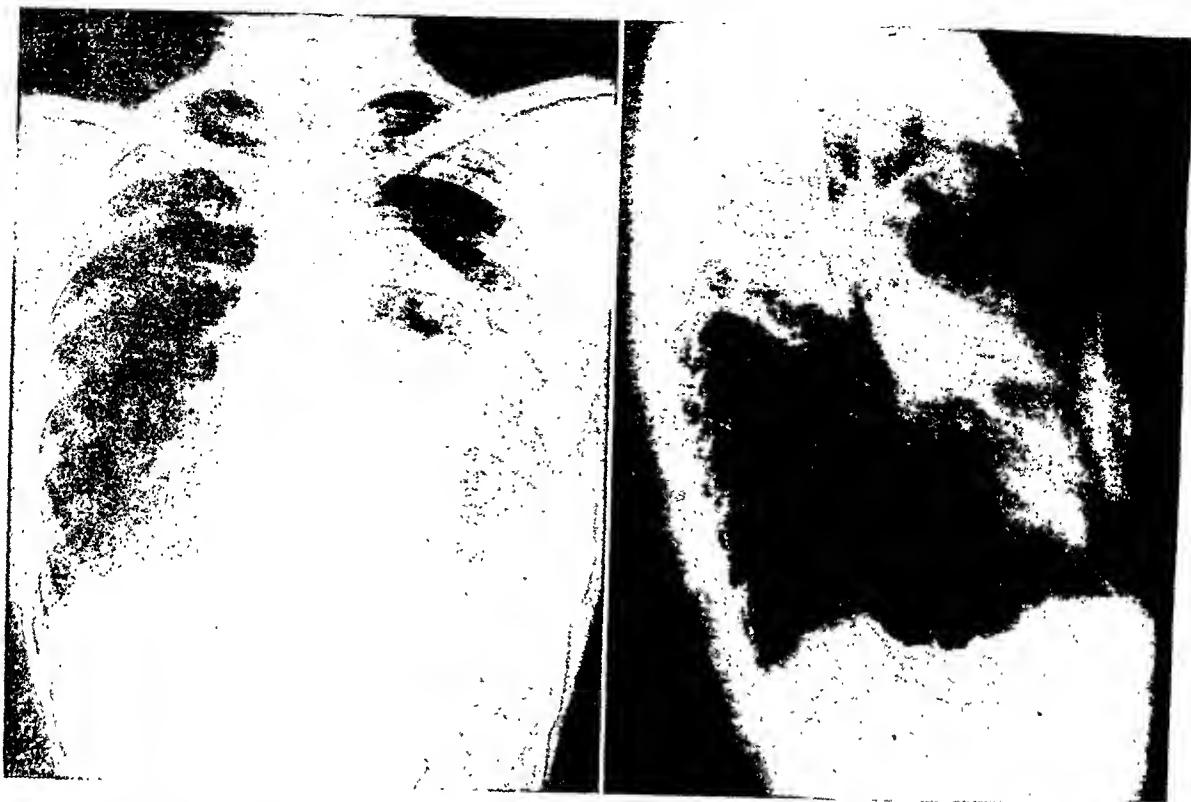


Fig. 1. A 46-year-old female entered the hospital because of hemoptysis of eleven weeks' duration. The right breast had been removed for carcinoma one year before. A partially cystic mass with calcification in the wall and containing air, fluid, and semisolid material arose from the left mediastinum. The dense area of calcification overlying the aortic arch was thought to represent an incompletely developed tooth fragment. Bronchoscopy was negative. Thoracotomy was done and a dermoid cyst was excised. There was a fistulous connection with a branch of the left upper lobe bronchus.

in the pleural cavity. All 3 patients died: one at operation; one the day following aspiration biopsy (death was not related to the operation so far as could be determined); and the third several months after x-ray therapy, with metastases in the liver and lumbar spine.

TUMORS OF NEUROGENIC ORIGIN

The group of neurogenic tumors was composed of 10 neurofibromata, 2 gangli-neuromata, and 2 cases diagnosed as neuroblastoma, which probably belong to the group commonly called sympathetic neuroblastoma. In 9 cases the tumor arose in the posterior mediastinum. This is readily understood, since the majority of nerves, including the sympathetic ganglia, are located in this area. Five tumors, however, arose in the anterior mediastinum. A recent report concerned neurofibromata arising from the vagus nerve (2). In some of our cases it has been diffi-

cult to determine the exact nerve from which the tumor originated. Although dumb-bell neurofibromata are relatively common, none of the present group was of that type.

There are no differential diagnostic points to characterize fibromata, gangli-neuromata, or the malignant variations of these types of tumor. Of the 14 neurogenic tumors, all were homogenous in density (Fig. 3). One was attached to the lower third of the esophagus in the middle portion of the mediastinum. The majority of the tumors were smooth: 4 showed slight lobulation. The size varied from 6 cm. in diameter up to a mass entirely filling one side of the chest. In 3 cases there was collapse of a lung, or a portion of the lung, due to pressure on a bronchus. In no instance was there fluid in the pleural cavity. Calcification was present in 3 cases.

It has been said that erosion of bone is





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Fig. 2. A 33-year-old male entered the hospital because of a superior mediastinal syndrome with extreme dyspnea. The possibility of malignant lymphoma was considered and a therapeutic trial of radiation was given. The mass continued to grow, however, and the patient re-entered the hospital in a critical condition three weeks later. An aspiration biopsy was done. Death occurred the following day, but not as a result of the operation. At autopsy, malignant teratoma was found in the right superior mediastinum, with metastases in the mediastinal lymph nodes and lung. Partial obstruction of the superior vena cava and atelectasis of the right upper lobe were present.

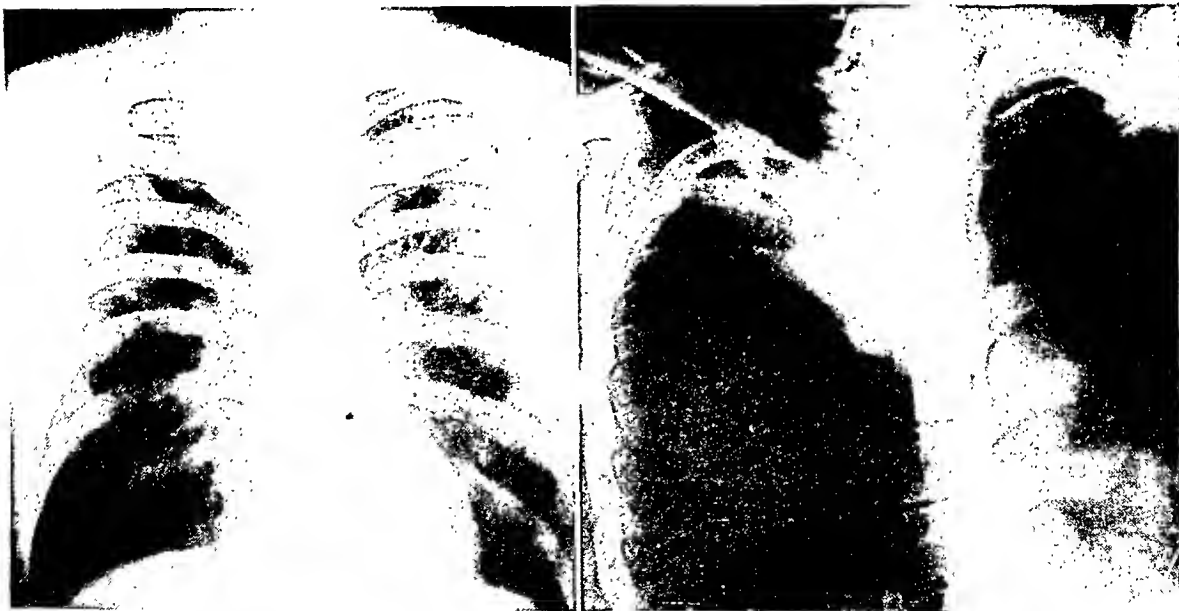


Fig. 3. A 24-year-old, single male entered the hospital with a three-year history of increasing nervousness, dyspnea, and palpitation on exertion. There had been no hemoptysis and no cough. There was a Horner's syndrome on the right. Roentgenologic examination of the chest revealed a smooth, sharply defined, rounded mass projecting into the right apex from the superior mediastinum. It lay in the posterior portion of the mediastinum. There was no evidence of bone erosion. The pleural reflection was well demonstrated in the oblique view. The tumor was incompletely removed. Histopathologic diagnosis: Ganglioneuroma.

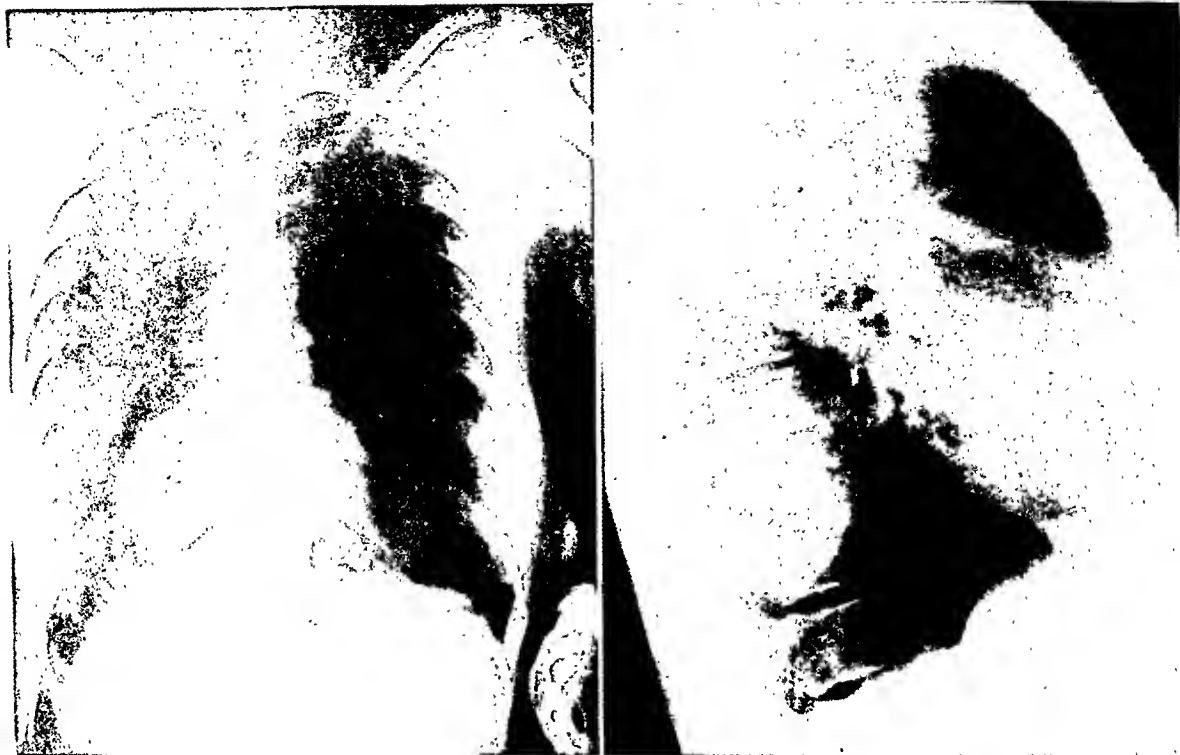


Fig. 4 A 41-year-old female entered the hospital for study of dyspnea. The onset followed an acute upper respiratory infection a year and a half before. Roentgen examination of the chest revealed a smooth, round, soft-tissue mass posteriorly, overlying the 8th to the 10th ribs. There was definite erosion of the 9th rib close to the region of the angle. A diagnosis of neurofibroma was made. The tumor was removed surgically. Histopathologic diagnosis: Neurofibroma.



Fig. 5 A 63-year-old male entered the hospital for diagnosis and treatment of a mass in the right superior mediastinum. This mass was discovered accidentally during investigation of pain in the region of the right shoulder. The patient received a therapeutic trial of x-ray irradiation elsewhere without effect. The mass lay in the mid-portion of the mediastinum displacing the trachea anteriorly and the esophagus to the left. It was attached to the trachea and was thought to represent a cyst. Operation showed it to be an intrathoracic colloid goiter. (This case was published as Case 29402, Case Records of the Massachusetts General Hospital, New England J. Med. 229: 595, 1943.)

indicative of malignancy. Six patients of this group showed bone changes which we have described as erosion. In this sense, however, the word "erosion" denotes an apparent wearing away of bone as from constant pressure (Fig. 4). These changes are similar to those seen in the spine due to aortic aneurysm. The term "erosion" has been applied in sharp contrast to "bone destruction," such as is seen in malignant bone lesions. In no instance in this group was there evidence of invasion of the bone by tumor.

Two of the neurogenic tumors were malignant, being diagnosed as neuroblastoma. From the roentgenologic examination there was nothing to indicate malignancy; neither case showed evidence of pleural fluid, bone destruction, or invasion of the lung. There was nothing in the history or in the roentgen examinations to indicate rapid growth of the lesion in either instance. Since the benign and the malignant tumors of this type cannot be differentiated, it becomes more apparent that surgery is the treatment of choice.

MALIGNANT TUMOR, UNCLASSIFIED

One of the group was a tumor presenting in the right mid-chest, which, prior to operation, was thought to be a benign lesion. It proved to be malignant but could not be classified. The patient had shown symptoms consistent with a superior mediastinal syndrome. Roentgenologically the tumor showed slight lobulation; there was some atelectasis within the lung, and a small amount of fluid within the pleural cavity.

TUMORS OF THYROID, PARATHYROID, AND THYMIC ORIGIN

Goiter: The easily recognized substernal goiter was not included in this series. It usually lies in the anterior superior mediastinum, has either a smooth or lobulated outline, and often shows an area of calcification. It is attached to the trachea, displacing it to one side or the other, with the greatest displacement at the largest



Fig. 6. A 22-year-old female entered the hospital for study. The bones showed the classical changes of hyperthyroidism. There had been previous explorations of the parathyroid areas. Roentgenologic examination of the chest revealed a 5×2.5 cm. mass in the right upper mediastinum, displacing the trachea and esophagus to the left. This mass was interpreted as a substernal parathyroid tumor. Operation and histopathologic examination confirmed this diagnosis. (This case was published as Case 25261, Case Records of the Massachusetts General Hospital, New England J. Med. 220: 1082, 1939.)

portion of the tumor. The displacement extends upward to the larynx (1).

Intrathoracic goiter (Fig. 5), in contrast to substernal goiter, may be mistaken for a mediastinal tumor roentgenologically. The two cases of intrathoracic goiter in our series were both diagnosed preoperatively as mediastinal cysts. One was located in the right antero-inferior mediastinum and was resting on the diaphragm; the second was in the right superior mediastinum, posterior to the trachea and displacing the esophagus. The tumors were smooth in outline and homogeneous in density. In each case, a small amount of atelectasis of lung was present; in neither was there evidence of bone change or fluid in the pleural cavity. At operation, the goiter in each case was found attached to the trachea, although in the one which rested on the diaphragm this attachment was not demonstrated roentgenologically.

Tumors of Parathyroids and Thymus: In only one case was a parathyroid tumor

visible roentgenologically, and this was found in the right superior mediastinum, displacing the trachea and esophagus to the left. Except for its appearance as a smooth mass, no special roentgen characteristics were noted. The diagnosis was aided considerably by the fact that the patient gave evidence of hyperparathyroidism both clinically and roentgenologically (Fig. 6).

One patient with myasthenia gravis had an unrecognized mass in the anterior mediastinum² which was in the region of the thymus, casting a shadow overlying the pulmonary artery, for which it was mistaken. On exploration this proved to be a benign thymoma.

DISCUSSION

It will be seen from the foregoing descriptions that no infallible roentgenologic characteristics, specific for each type of mediastinal tumor, have been demonstrated, although certain findings are suggestive. Nor are the clinical findings of diagnostic value in differentiating types of tumor. In many instances, the discovery of a mediastinal tumor is purely accidental and, because of this fact, it is probable that an apparent increase in the incidence of all types of mediastinal tumors will follow the increase in routine chest examinations which World War II has brought about.

In order to demonstrate successfully a mediastinal tumor, the roentgenologic technique requires first roentgenoscopy, which will show the dynamics of the tumor and its attachments and will determine the films to be taken. The minimum necessary roentgenograms include the routine postero-anterior view, a lateral view, and an over-exposed anteroposterior view with the Potter-Bucky diaphragm. Occasionally oblique views are of definite diagnostic value. Tracheal attachment of the tumor is readily demonstrable by having the patient swallow, and noting if the mass moves

with the trachea. Any mass attached to the trachea can give this sign. The more common lesions which produce it are intrathoracic thyroid, bronchiogenic cyst, and aneurysm of the innominate artery, and it should be remembered that any one of these lesions may show transmitted pulsation. Pressure of the tumor against the esophagus may be discovered by the demonstration of an extrinsic pressure defect. In some cases intramural, extramucosal involvement of the esophagus by the tumor (7) may be revealed with the aid of roentgenoscopy and "spot" films. Tumors located in the wall of the esophagus are likely to be of the spindle-cell type or bronchiogenic cysts.

The postero-anterior and lateral roentgenograms as a rule indicate the location of the mass in the chest. It is at times difficult, however, to determine whether the tumor lies within the mediastinum or in the parenchyma of the lung. If the pleural reflection at the edge of the tumor can be demonstrated (and for this an over-exposed view in addition to the ordinary technic may be required) the tumor can be located with greater accuracy. Although we have not had very successful results after injection of air into the pleural cavity, it seems as if accurate localization of the tumor should be possible by this method. Once the location of the mass is definite, its configuration and its effect on adjacent structures (such as pressure on the bronchi, rib erosion, or attachment to the esophagus or trachea) are of further diagnostic value. Moore (4) found laminagrams valuable in separating the mass from other structures within the mediastinum. Reynolds and Leucutia (5) suggest as a final diagnostic procedure a trial dose of radiation.

CONCLUSIONS

With the present methods of roentgenologic examination no exact differentiation of mediastinal tumors is possible. Certain diagnostic features in various types of tumor have been demonstrated, however. The most important of these are as follows:

² Detailed studies of thymic tumors and myasthenia gravis from surgical, medical, and roentgenologic standpoints are in preparation by Oliver Cope, M.D., of this hospital, and it is through his courtesy that this case is included.

Congenital Tumors

Bronchiogenic Cysts: A round or ovoid tumor located anywhere within the mediastinum without evidence of calcification or bone erosion.

Dermoid Cysts and Teratomata: A mass, slightly more irregular in outline, located in the anterior mediastinum, which may contain foci of calcification.

Neurogenic Tumors: Any one of these tumors is usually smooth in outline, homogeneous in density, and may be located in any portion of the mediastinum. Bone erosion (contradistinguished from bone destruction) is commonly associated with this type of tumor.

Tumors of Thyroid, Parathyroid, and Thymic Origin: The outstanding finding in intrathoracic goiter is its attachment to the trachea. Parathyroid and thymic tumors may be recognized as mediastinal tumors but their significance is largely dependent upon

other roentgenologic or clinical characteristics.

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A Statistical Analysis of 100,000 Examinations of the Chest by the Photoroentgen Method¹

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IN THE ACCOMPANYING tables are presented the results of routine examinations of the chest by the photoroentgen method in 100,000 consecutive selectees forwarded for possible induction to an Armed Forces Induction Station. All of the chest films were interpreted by one or the other of the authors; many of them were seen by both authors before acceptance or rejection was advised.

THE METHOD

The routine roentgenologic examination of the chest by means of stereoscopic 14 × 17-in. films has until recently been the method of choice for the detection of tuberculosis of the lungs. The introduction and perfection of the photoroentgen method, using 4 × 10-in. film, on which are obtained stereoscopic exposures of the chest, has made obsolete the older method. The economy resulting from the use of the smaller film (the basic cost of these films being about one-twentieth that incurred when using stereoscopic 14 × 17-in. films) is the major factor involved in mass surveys, either in or out of the Army. But the concentrated field of vision, the sharpness and definition of the image on the smaller film, and the rapidity with which interpretation can be made are added factors favoring this method of examination. The use of a Lysholm grid in front of the intensifying screen is a factor in the production of superior film quality.

APPARATUS

In the case of the examinations here reported, the energizing unit happened to

be of General Electric X-Ray Corporation design and manufacture, with the General Electric Photoroentgen Unit. The Lysholm grid was used in all examinations. The technic varied slightly from time to time, but in the main consisted in the use of approximately 85 kv.; 175–200 ma., a target-screen distance of 40 in., and an average exposure time of 0.25 second. Tube life has been satisfactory, considering the speed with which examinations have to be made. The maintenance of a schedule of one examination each 45 seconds will result in increased tube life. Any deviation from this schedule tending toward a more rapid rate of examination will inevitably tend to greater tube cost.

SCOPE OF THIS REPORT

All selectees, and others reporting to this station for physical examination, were routinely examined by this method. Films

TABLE I: CHEST LESIONS DISCOVERED BY PHOTOROENTGENOGRAPHY IN 100,000 SELECTEES

	White	Colored	Total
Disqualifying lesions	489	862	1,351 (1.35%)
Non-disqualifying lesions	578	684	1,262 (1.26%)
Total	1,067	1,546	2,613 (2.61%)

are reviewed and a report is made prior to a decision as to acceptability or rejection for service. Special emphasis is naturally placed on the detection and elimination of pulmonary tuberculosis, though an attempt has been made to record accurately all abnormal findings on chest examination. The present report deals only with the results of chest examination in 100,000 consecutive selectees reporting to this station during the latter part of 1942 and the early part of 1943. Of the selectees

¹ From The Armed Forces Induction Station, Fort Bragg, N. C. Accepted for publication in December 1943

TABLE II: LESIONS OF THE THORACIC CAGE

	Rejections for Thoracic Cage Lesions			Non-Disqualifying X-Ray Findings			Total with Thoracic Cage Lesions			Rejection Rate per Thousand		
	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total
I. Deformities of thorax												
(a) Asymmetry	..	2	2	4	2	6	4	4	8	..	0.02	0.02
1. Congenital	..	..	..	..	..	..	..	..	..	..	..	..
2. Traumatic	..	..	..	..	..	..	..	..	..	..	..	..
II. Clavicles												
(a) Absence	..	1	1	..	..	..	..	1	1	..	0.01	0.01
(b) Fractured	1	2	3	3	3	6	4	5	9	0.01	0.02	0.03
III. Ribs												
(a) Cervical	..	..	..	130	123	253	130	123	253	..	..	..
(b) Deformed and defective												
1. Congenital												
Fusion and forking	..	..	..	11	18	29	11	18	29	..	..	..
Synchondrosis 1st ribs	..	..	..	..	7	7	..	7	7	..	..	..
Rudimentary 1st ribs	..	..	..	4	12	16	4	12	16	..	..	..
Deformed ribs	..	..	..	3	3	6	3	3	6	..	..	..
2. Traumatic and diseased												
Result of thoracotomy	..	6	6	7	17	24	7	23	30	..	0.06	0.06
Fractured	1	..	1	10	13	23	11	13	24	0.01	..	0.01
Tumors	2	1	3	..	..	..	2	1	3	0.02	0.01	0.03
Early calcification of costal cartilages	..	..	..	14	9	23	14	9	23	..	..	..
IV. Vertebral column												
(a) Kyphoscoliosis	27	8	35	3	1	4	30	9	39	0.27	0.08	0.35
(b) Scoliosis	39	10	49	50	43	93	89	53	142	0.39	0.10	0.49
(c) Fractures	2	1	3	..	..	..	2	1	3	0.02	0.01	0.03
V. Diaphragm												
(a) Congenital weakening	6	..	6	3	1	4	9	1	10	0.06	..	0.06
(b) Eventration	3	4	7	..	..	..	3	4	7	0.03	0.04	0.07
(c) Hernia	..	1	1	..	..	..	..	1	1	..	0.01	0.01
VI. Foreign bodies												
(a) Soft tissues—thoracic wall	1	..	1	70	22	92	71	22	93	0.01	..	0.01
TOTAL	82	36	118	312	274	586	394	310	704	0.82	0.36	1.18

examined, 45,557 were white, and 54,443 were colored or non-white.

GENERAL SUMMARY AND EXPLANATION OF STATISTICAL TABLES

Of the 100,000 men examined, a total of 1,351, or 1.35 per cent, were rejected for military service because of the presence of chest disease alone: 489 white (1.07 per cent) and 862 non-white (1.58 per cent). In addition, 578 white and 684 colored selectees presented non-disqualifying chest findings regarded as worthy of note, comprising 1.26 per cent of all men examined. Abnormal findings, disqualifying and non-disqualifying, were recorded in 2.61 per cent of all those examined (Table I).

The disqualifying and non-disqualifying lesions and abnormalities of the thoracic cage are listed in Table II. In this group

36 white and 82 colored (118 total) were rejected (1.18 per thousand); 274 white and 312 colored (586 total) presented non-disqualifying chest wall findings. The incidence of conditions involving the thoracic cage was 7.04 per thousand.

The incidence of various tuberculous processes within the chest is shown in Table III. The classifications were arbitrary, not confirmed by prolonged clinical observation or study, and they are therefore subject to later modification not within the scope of this survey. Decision had to be made with induction or rejection (either permanent or temporary) as the end-result of that decision in each case. One hundred and twenty-nine white and 145 colored selectees were rejected for active pulmonary tuberculosis—a total (combined) rejection rate of 2.74 per thou-

TABLE III: PULMONARY TUBERCULOSIS

	Rejections			Non-Disqualifying X-Ray Findings			Total with Tuberculosis			Under Minimum Height and Weight Standards			Rejection Rate per Thousand		
	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total
I Active															
(a) Primary															
1 Tracheobronchial	1	...	1	..	..	..	1	...	1	..	..	..	0.01	..	0.01
2 Primary complex	...	2	2	..	..	..	...	2	2	..	1	1	..	0.02	0.02
3 Parenchymal	...	...	...	..	..	..	...	...	...	..	..	..	..	..	..
(b) Reinfection type															
1 Minimal	9	12	21	..	..	..	9	12	21	..	4	4	0.09	0.12	0.21
2 Moderately advanced	88	83	171	..	..	..	88	83	171	14	22	36	0.88	0.83	1.71
With cavitation	15	10	25	..	..	..	15	10	25	5	3	8	0.15	0.10	0.25
3 Far-advanced	11	5	16	..	..	..	11	5	16	3	3	6	0.11	0.05	0.16
With cavitation	14	12	26	..	..	..	14	12	26	9	8	17	0.14	0.12	0.26
(c) Acute															
1 Miliary	2	...	2	..	..	..	2	..	2	1	..	1	0.02	..	0.02
2 Hematogenous	1	1	2	..	..	..	1	1	2	..	..	..	0.01	0.01	0.02
(d) Moderately advanced with therapeutic pneumothorax	3	3	6	..	..	..	3	3	6	..	..	..	0.03	0.03	0.06
(e) Pleuritis, tuberculous	1	1	2	..	..	..	1	1	2	1	1	2	0.01	0.01	0.02
TOTAL	145	129	274	..	..	..	145	129	274	33	42	75	1.45	1.29	2.74
II Arrested															
(a) Primary															
1 Primary calcified nodes	4	6	10	32	43	75	36	49	85	2	3	5	0.04	0.06	0.10
(b) Reinfection type															
1 Minimal parenchymal	34	36	70	13	3	16	47	39	86	3	10	13	0.34	0.36	0.70
2 Moderately advanced	61	66	127	..	..	..	61	66	127	8	12	20	0.61	0.66	1.27
TOTAL	99	108	207	45	46	91	144	154	298	13	25	38	0.99	1.08	2.07
III Questionable activity	3	7	10	..	..	..	3	7	10	..	2	2	0.03	0.07	0.10
GRAND TOTAL	247	244	491	45	46	91	292	290	582	49	69	115	2.47	2.44	4.91

TABLE IV: PULMONARY TUBERCULOSIS: SUMMARY

	Active			Arrested			Questionable Activity			Total		
	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total
Rejected for tuberculosis	145	129	274	99	108	207	3	7	10	247	244	491
Non-disqualifying x-ray findings	..	..	..	45	46	91	..	..	..	45	46	91
Total with tuberculous lesions	145	129	274	144	154	298	3	7	10	292	290	582
Under minimum height and weight standards	33	42	75	13	25	38	..	2	2	49	69	115
Rejection rate per 1,000	1.45	1.29	2.74	0.99	1.08	2.07	0.3	0.7	0.10	2.47	2.44	4.91

and examined. Of these men, 42 white and 33 colored were below the standards of weight for acceptance. In the group presenting arrested tuberculous lesions (opinion of examiner) were 108 white and 99 colored selectees (207 rejections), giving a rejection rate of 2.07 per thousand. Only 46 white and 45 colored selectees presented

arrested tuberculous processes which were considered non-disqualifying and acceptable for induction.

All cases of pulmonary tuberculosis reported in this series are shown in Table IV. Of the 491 selectees rejected, 244 were white and 247 were colored or non-white; 91 men were accepted with what

TABLE V: NON-TUBERCULOUS LUNG AND PLEURAL LESIONS

	Rejections			Non-Disqualifying X-Ray Findings			Total			Under Minimum Height and Weight Standards			Rejection Rate per Thousand		
	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total
I. Congenital															
(a) Azygos lobe	...	...	...	55	50	105	55	50	105	..	..	..	..	..	..
(b) Cystic lung disease	2	1	3	...	...	...	2	1	3	..	1	1	0.02	0.01	0.03
II. Traumatic															
(a) Pneumothorax, traumatic and spontaneous	2	3	5	...	...	...	2	3	5	1	..	1	0.02	0.03	0.05
(b) Foreign body, lungs	4	...	4	...	...	...	4	...	4	..	..	..	0.04	..	0.04
III. Infections and non-infections															
(a) Pulmonary infiltration: type undetermined	27	32	59	...	...	...	27	32	59	1	4	5	0.27	0.32	0.59
(b) Lung abscess	7	3	10	...	...	...	7	3	10	2	1	3	0.07	0.03	0.10
(c) Tracheobronchial lymphadenopathy	43	14	57	...	...	...	43	14	57	2	3	5	0.43	0.14	0.57
(d) Heavy root shadows	9	4	13	123	104	227	132	108	240	1	4	5	0.09	0.04	0.13
(e) Fibrosis: type undetermined	4	2	6	32	27	59	36	29	65	..	4	4	0.04	0.02	0.06
(f) Empyema															
1. Sacculated	1	1	2	...	...	...	1	1	2	1	..	1	0.01	0.01	0.02
2. Non-sacculated	1	1	2	...	...	...	1	1	2	..	..	..	0.01	0.01	0.02
(g) Pleuritis															
1. Adhesive	30	19	49	73	42	115	103	61	164	5	3	8	0.30	0.19	0.49
2. With effusion															
Sacculated	19	7	26	1	...	1	20	7	27	3	..	3	0.19	0.07	0.26
Non-sacculated	5	2	7	1	...	1	6	2	8	..	..	..	0.05	0.02	0.07
Calcified	4	1	5	1	1	2	5	2	7	..	..	..	0.04	0.01	0.05
(h) Pneumoconiosis	8	7	15	...	...	...	8	7	15	1	2	3	0.08	0.07	0.15
1. Mycosis	1	...	1	...	...	...	1	...	1	..	..	..	0.01	..	0.01
(i) Bronchiectasis	42	32	74	...	...	...	42	32	74	3	11	14	0.42	0.32	0.74
(j) Tumors															
1. Lungs	6	2	8	...	...	...	6	2	8	..	..	..	0.06	0.02	0.08
2. Mediastinum	2	...	2	...	...	...	2	...	2	..	..	..	0.02	..	0.02
3. Pleurae	...	1	1	...	...	...	...	1	1	..	..	..	..	0.01	0.01
(k) Emphysema	4	2	6	...	...	...	4	2	6	2	1	3	0.04	0.02	0.06
TOTAL	221	134	355	286	224	510	507	358	865	22	34	56	2.21	1.34	3.55

were considered arrested or healed tuberculous lesions. Of the total 582 men, approximately 20 per cent were below the acceptable weight standards for their height.

All non-tuberculous conditions of the lungs and pleurae were recorded and are shown in Table V. Three hundred and fifty-eight white and 507 colored or non-white presented some abnormality which was considered to be non-tuberculous. In 224 white and 286 colored or non-white (510 total) the condition was non-disqualifying in the opinion of the examiner. One hundred and thirty-four white and

221 colored or non-white selectees were rejected for non-tuberculous pulmonary or pleural lesions (355 total), a rejection rate of 3.55 per thousand examined. Of these men, only 56 were under the acceptable standards for weight.

Abnormalities of the heart, pericardium, and great vessels were also recorded. A total of 462 men (109 white and 353 colored or non-white) presented what were considered significant findings. Only 75 of this group were considered qualified for induction; 387 were rejected (75 white and 312 colored or non-white), giving a rejection rate of 3.87 per thousand. Twelve white

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Further Experiences with Venography¹

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OUR EXPERIENCE with venography now includes over 350 cases. Technical considerations and anatomical and physiological observations covering the first third of this series have been recorded in a previous paper (1). A brief review of the technic follows.

Twenty cubic centimeters of contrast medium (diodrast) are injected into any accessible vein below the ankle, through a 25- or 26-gauge needle. A venipuncture is made through the skin without incision. The dye is injected over a period of two minutes. Three 14 × 17-in. films are used, with two exposures to a film, using one half of the film for each. The paired exposures are made from stereo positions. Two exposures cover the area from the ankle to the knee; two the area of the upper leg, knee, and lower thigh; and two the remainder of the thigh and the lower pelvis. The first exposure is made just after the injection of approximately 7 c.c., or after forty seconds have elapsed from the beginning of the injection. The other five exposures follow in rapid succession, the last being completed at approximately the time of completion of the injection, or two minutes after the beginning of the procedure. These exposures give three overlapping pairs of films including the area from the ankle to the lower pelvis.

In the normal subject the dye, passing upward, through the veins of the leg, clearly demonstrates the venous system. In the case of disease and slowing of the venous stream, the time element involved is such that in most cases visualization of the venous tree is obtained.

On the basis of a large number of cases in which a block of the venous stream was demonstrable at some point, it appears

that for purposes of interpretation, the venous structures of the leg and thigh can be divided very simply into a superficial plexus and the deep veins. These two systems of venous return have many communications both in the leg and in the thigh. The internal saphenous, which is the normal collecting agency of the superficial plexus, and the femoral vein, which is the normal collection agency for the deep veins of the leg and knee, unite at the femoral fossa, forming the external iliac vein.

The number of cases now observed seems to be sufficient to warrant an attempt at classification of the abnormal or pathological venograms into definite types or patterns. We have taken 100 consecutive cases observed within recent months and arranged these according to the patterns presented. Table I shows how these cases fall into classes.

TABLE I: CLASSIFICATION OF VENOGRAPHIC PATTERNS IN 100 CONSECUTIVE CASES

SUPERFICIAL BLOCK (ONLY).....	44
Acute	
Leg.....	7
Leg and thigh.....	11
Chronic	
Leg.....	6
Leg and thigh.....	19
Acute and chronic	
Leg.....	1
DEEP BLOCK.....	50
Acute	
Leg.....	4
Leg and thigh.....	7
Chronic	
Leg.....	9
Thigh.....	2
Leg and thigh.....	28
NORMAL.....	4
INCONCLUSIVE.....	2

This classification seems necessary for several reasons. First, from the clinical standpoint, a venogram is made primarily to give the surgeon a clue as to proper treatment of the affected leg. Treatment of a block of the superficial plexus usually does not involve as radical measures as

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.



Fig. 1. Acute superficial block, showing non-tortuous vessels of even caliber.



Fig. 2. Chronic superficial block: tortuous vessels of uneven caliber. Normal deep vessels visualized.

when the deep circulation is involved. Again, a classification according to definite patterns may help the radiologist who sees only a few such procedures better to understand and interpret the occasional venogram.

Throughout this paper, we prefer to use the word block rather than the term phlebitis, phlebothrombosis (2), or bland thrombosis (3). From the standpoint of the radiologist, the dye pattern in most cases actually demonstrates a block. The roentgenogram reveals no evidence of the etiology but indicates definitely the site and frequently the extent of the block. The table divides these patterns, then, into superficial and deep block, with subdivisions into acute and chronic.

Of these 100 cases, 44 showed evidence of superficial block, with the deep circulation intact. We feel definitely that this particular group would not be observed,

or would at least be diagnosed only infrequently, by methods of single observation. Multiple observations are necessary to avoid mistakes in recognizing many of these patterns. In the acute superficial block, a portion of the dye goes into the deep circulation in the region of the ankle or just above. The deep circulation of the leg is visualized from this point upward to the femoral fossa. In the superficial circulation, the veins are comparatively straight and not tortuous (Fig. 1). The caliber of the separate veins is even. The dye spreads through the superficial plexus to the point of block. In the region of the block, two things may be observed.

The first and most easily demonstrated pattern shows the dye stopping abruptly at the site of a connecting vessel and turning directly inward or somewhat backward toward the deep circulation or another area

of the superficial plexus. From the point of block upward, no superficial plexus is demonstrated in the area of the block. The second pattern—slightly more difficult to recognize—in acute superficial block shows short lengths of straight, non-tortuous, and non-dilated veins extending upward and apparently fading out in the tissues. The difficulty in recognition of this pattern lies in the fact that the dye in the particular vein may be going upward slowly and a single observation may be incorrect. Two or preferably four films showing the dye fading out at the same point on all exposures give a definite clue to a block above the area where the dye is last visualized. Acute superficial block is frequently seen in the presence of chronic disease of the deep or superficial circulation.

In the chronic superficial block, the veins visualized are dilated and tortuous (Fig. 2) and the passage of the dye upward is usually slow. In films showing proper soft-tissue detail, numerous dilated, varicose veins in the superficial tissues which do not fill with the dye are frequently seen. The deep circulation is, of course, visualized and the deep veins may show some dilatation and tortuosity of slight degree. It is not uncommon for the upward passage of the dye in the deep veins to be slow. In the presence of chronic superficial block, small connecting veins can be seen extending inward toward the deep circulation or outward from the deep circulation for a distance of 1 to 3 cm. These veins appear to end abruptly in the tissues. With this pattern, as with acute superficial block, the dye occasionally turns abruptly inward toward the deep circulation or toward another area of the superficial plexus. Also, areas of superficial circulation are not demonstrable. The distinguishing characteristic of chronic as opposed to acute disease, whether in the superficial or the deep circulation, is the tortuosity of the veins and the considerable increase in their lumen. A very few cases have shown definite evidence of acute and chronic block at the same time.



Fig. 3. Acute deep block, showing normal superficial vessels and non-visualization of deep vessels.

It is perfectly possible to overlook an acute block in a leg showing a long-standing chronic block of considerable extent. Fortunately, the demonstration of the chronic block, its degree and extent, is of paramount clinical importance in selecting the type of therapy which will give the most benefit.

Referring again to the table, we find that in this series of 100 cases deep block was demonstrated 50 times. Of these cases, 11 were acute. In all 11 of these acute cases of partial or complete block of the deep circulation of the leg and thigh, definite evidence of acute block in the superficial circulation was also demonstrable. This adds evidence to the theory that deep, acute phlebitis originates primarily in the superficial circulation. In the pattern showing acute deep block (Fig. 3), there is no visualization of the deep cir-

culuation of the part of the leg or thigh involved. This is also true of deep chronic block. How then make the distinction?

The evidence is to be found in the character of the superficial plexus carrying the dye. In the acute process involving the deep circulation, the superficial circulation presents essentially the same appearance as in acute superficial block: The veins are straight and not tortuous. Anastomoses are frequent and numerous. At one or more points in the superficial circulation, definite evidence of block is demonstrated. The dye usually tends to collect into the internal saphenous and finally passes upward to the femoral fossa by means of the internal saphenous. Occasionally, in this type of case, a superficial vein may be found to be partly outlined by the dye and a thrombus may be demonstrable in this vein. Again, with the acute deep block, a small amount of dye may get into a portion of the deep circulation and reveal a thrombotic process there. The patterns of thrombosis will be discussed later.

The pattern of the chronic deep block (Fig. 4) is the easiest to recognize of any venographic patterns which we have seen. The deep circulation is absent in whole or in part. The dye usually enters branches of the internal saphenous rather promptly, and by the time the region of the knee is reached, all of the dye is returning upward through that vein. The entire internal saphenous from the femoral fossa downward well into the leg is dilated and usually quite tortuous, and from the physiological standpoint the upward passage of the dye is considerably slowed. Coming off from the internal saphenous can be seen short lengths of communicating veins which fade out into the tissues. These veins are considerably larger than the usual normal communicating vein and are frequently very tortuous. In cases where this chronic deep block involves the leg alone, most of the dye returns by means of communicating veins above the knee to the femoral vein.

It is perhaps fortunate that this pat-

tern of chronic deep block is easily recognizable. Patients with a complete block of the entire deep circulation of the leg and thigh are frequently the ones showing very large, dilated, superficial varicosities extending from the mid-leg upward along the inner portion of the leg, knee, and thigh. These veins are a temptation to any surgeon. The venogram shows that the tortuous, dilated vein is a main channel for carrying the blood flow upward to the femoral fossa. Clinical tests in this type of case may apparently demonstrate a competent deep circulation when the venogram shows none to exist. This type of leg should be treated conservatively. Radical measures will usually aggravate the condition.

Four cases in this series of 100 were considered essentially normal. Two cases in the series were inconclusive and in these no attempt at diagnosis was made. This percentage of inconclusive results is very much smaller than we expected or than we had in our first 100 cases.

TABLE II: PATTERNS IN FRACTURE, THROMBOSIS, AND WHEN PUDENDAL CIRCULATION IS VISUALIZED

FRACTURE.....	5
Acute deep block in leg.....	1
Chronic deep block in leg.....	1
Chronic superficial block in leg.....	1
Chronic superficial block in leg }	2
Chronic deep block in leg }	
THROMBOSIS.....	2
Acute deep block in thigh.....	
Acute superficial in leg.....	1
Chronic superficial in leg.....	1
PUDENDAL.....	4
Chronic deep block of leg with acute and chronic superficial block.....	1
Chronic deep block of leg and thigh.....	2
Chronic deep block of leg and thigh with chronic superficial block of leg.....	1

In this series of 100 cases (Table II), examination was made five times in cases of fracture with persistent swelling of the leg. In all five of these cases, definite evidence of superficial or deep block could be demonstrated. In the total number of cases examined, other fractures have been investigated. In every instance where a fracture has occurred and a venogram has been made within a short time or within some months thereafter, evidence of block

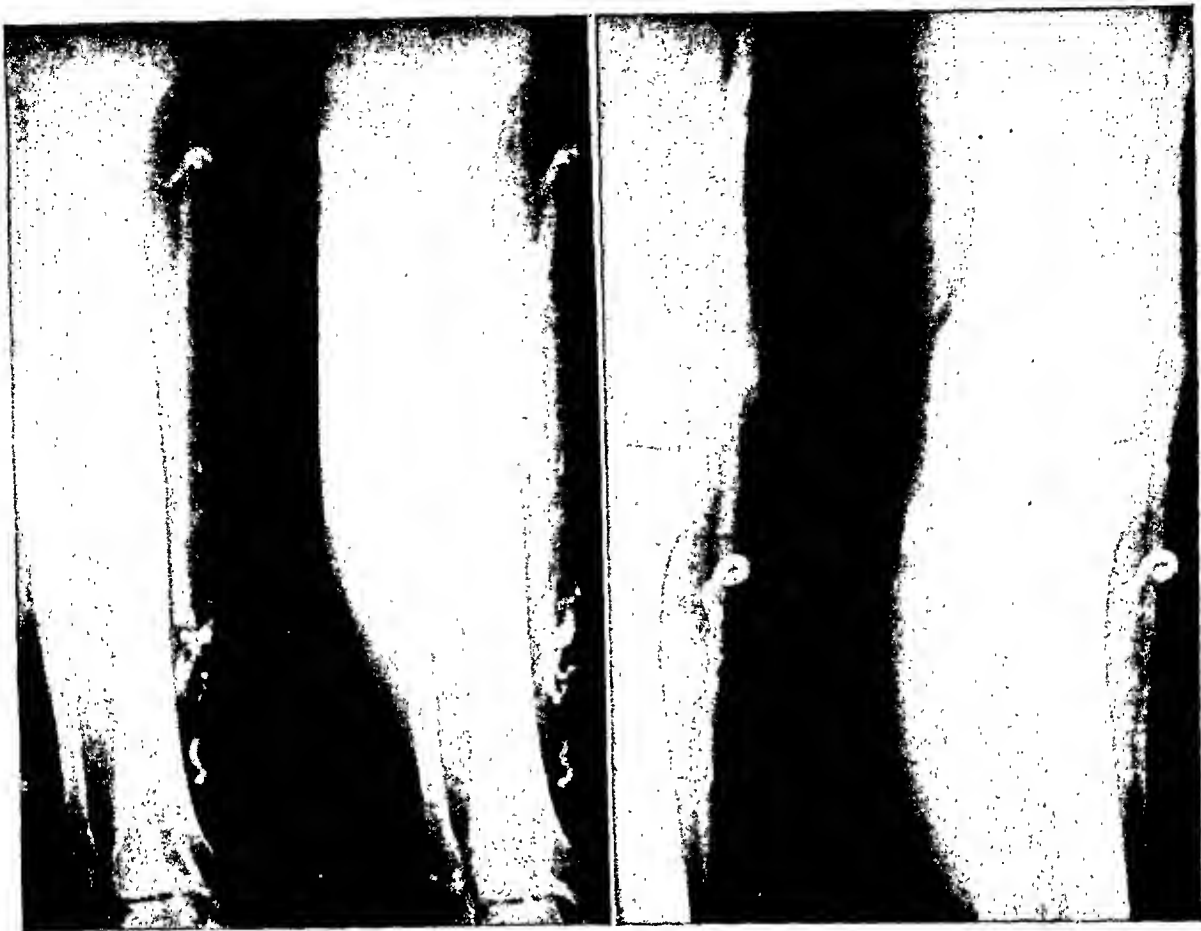


Fig. 4. Chronic deep block, showing dilated superficial vessels with blocked communicating branches.

could be demonstrated in the venous system. All of these cases have shown persistent edema.

In the 100 cases, two examples of definite thrombus were observed. The patterns of thrombosis as seen in our total series were of three different types. In the first type, we find a sudden block of a vessel. The head of the column of dye at the site of the block is concave and gives a definite impression that the lumen of the vein contains a mass that the dye is beginning to outline. The second pattern is one in which the vein is not completely obliterated but shows a ragged, irregular area extending for a short or longer distance along the wall. The third pattern is the one so well described by Bauer (4), in which the dye follows the wall of the vein and outlines a mass within the lumen.

In cases where the block has involved the external iliac vein, the dye returning

from the leg to the body has followed four patterns. In this series of 100 cases, it will be observed (Table II) that the pudendal circulation has been demonstrated four different times. Of the four patterns mentioned, all have been seen in the total series. One of the types or patterns has been seen but once, and that in a case of acute deep block involving the upper femoral and external iliac vein. The dye proceeded outward from the upper portion of the internal saphenous in the thigh and extended into a network of superficial veins, gradually extending backward from the inner part of the thigh toward its posterior portion. In veins extending upward in this posterior portion the dye was lost. The other three types have all involved the pudendal circulation.

The second pattern is the one that is probably best known clinically. The dye comes out into the pudendal circulation

and spreads upward through anastomoses with the veins in the lower portion of the abdominal wall, and thus into the body.

In the third type of return, which has been seen several times, the dye comes out into the pudendal circulation in the region of the femoral fossa. It extends across the body, apparently in one of the branches of the pudendal circulation, which anastomoses with the pudendal circulation of the opposite side. The dye takes a retrograde course through this portion of the pudendal circulation to the opposite femoral fossa. At that point, it enters the internal saphenous and travels upward through the external iliac of the opposite side. This type of circulation has been seen in its entirety.

The fourth type has been somewhat more difficult to trace. The dye enters the pudendal circulation and its anastomoses with the peroneal veins, flowing backward and upward through the latter into the pelvis. Most of this dye appears to collect in a rather deep vessel lying somewhat anterior to the sacrum and running laterally in the posterior portion of the pelvis. This vein, which is of fair caliber, finally empties into the external iliac vein at the level of the lower portion of the sacroiliac joint.

A few further observations should be made in regard to the physiological return of the dye in the leg. We have tried elevating the head of the table so that the patient is at an angle of 15 degrees from the horizontal with the head up and the feet down. In this particular position in the normal case, the dye return seems to be approximately as rapid as with the patient completely supine. Where there is any slowing of the stream or any evidence of acute or chronic block, however, the upward passage of the dye is delayed very much longer than with the patient supine. We were unable to predict with any satisfaction the time that the passage

of the dye would take in the pathological case. As a consequence, the visualization of the vessels in the thigh, and occasionally in the upper leg, was frequently poor or completely missed. Unsatisfactory visualization occurred in too many cases for continuance of this type of procedure.

With the patient in the opposite direction, the head down and the feet up, again with the table at an angle of 15 degrees from the horizontal, the upward passage of the dye showed no marked change as compared with the supine position. The practice was not continued because of the difficulty of maintaining the patient in this position for any length of time.

SUMMARY

We have presented a method of venography which in our hands has given practically complete visualization of the veins of the entire leg, thigh, and lower pelvis in *most* cases. The venograms are classified into types or patterns, indicating acute and chronic block of the superficial and of the deep plexuses. Three types of venous thrombosis have been observed and described. Four methods of abnormal venous return from the thigh to the body have been demonstrated. We believe that the procedure when properly done gives highly accurate information.

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The Antero-Posterior Lordotic Projection in the Roentgenographic Examination of the Lungs¹

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THE CONVENTIONAL radiographic examination of the lungs, especially when supplemented by fluoroscopy and films taken in the oblique and lateral projections, is usually satisfactory for the demonstration of pulmonary disease. In some cases, however, additional examination of the apices is necessary. The importance of this special examination is emphasized by the fact that in a large proportion of cases tuberculous infiltrations are present in the apical and subapical areas. The importance of demonstrating a small infiltration, with or without cavitation, is obvious.

It is the purpose of this paper to describe the anteroposterior lordotic projection, by means of which the pulmonary apices may be better visualized than they are in the usual projections, and to render clear its usefulness. No claim is made for originality, since Fleischner (2) and, particularly, Lindblom (4) have used this projection and described its application in pulmonary disease. Cole (1) likewise has used this projection in the study of the pulmonary artery. The method of examination has been described in two of the manuals on technic which were available to us (5, 7).

Roentgenographically, the apical portion is arbitrarily designated as that part of the lung seen behind and above the clavicle in films taken in the postero-anterior position. There are many anatomic structures which are found in this region (3) and which contribute shadows which may be seen on the roentgen film. These are:

1. The skin and subcutaneous tissues.
2. A muscle group, consisting mainly of the sternomastoid, the scapular, and erector spinae muscles.
3. A vasculo-nervous sheath in which

are included the subclavian vein, the subclavian artery and its branches, as well as some of the branches of the brachial plexus.

4. The clavicles, particularly, and to a lesser extent the posterior and lateral portions of the upper three or four ribs. These produce the most important obscuring shadows, especially if the film is slightly underexposed. The anterior portion of the first rib and its costal cartilage also contribute occasionally to the obscuration of the lung apices.

Various radiographic means have been employed to obtain clear views of the apices in those cases which present confusing or doubtful shadows. It has been suggested that the clavicles may be displaced either by elevation of the arms alone or by elevation of the arms plus elevation of the roentgen-ray tube and projection of the central ray of the roentgen beam 15 to 20 degrees caudally (6). The objection to the latter method is that in some cases it produces obliteration of the entire apex of the lung. Very frequently, too, only the lateral half of the clavicle is elevated and the mesial half, which is not elevated, prevents adequate visualization of part of the lung apex.

Examination of the chest in deep expiration (6) results in depression of the clavicles. Where good clavicular motion is present, a descent of 1 to 2 cm. may be obtained. Since motion of the clavicles depends on motion of the bony thorax, the value of this projection is limited where there is restriction in the movement of the bony cage either as a result of intrathoracic disease or because of an antecedent operation.

Another procedure is one requiring overpenetration of the film or exposure with

¹ From the Roentgenologic Service, Lovell General Hospital, Fort Devens, Mass. Accepted for publication in December 1943.



Figs. 1 and 2. Posture of patient for anteroposterior lordotic projection.

a Potter-Bucky diaphragm. Laminagraphy is still another method. These last three methods have definite value and are useful in detection of cavitation in a dense shadow. Laminagraphy has an unquestioned place and value in the investigation of pulmonary disease, but many feel that the use of the added number of films is unwarranted during the National Emergency. Moreover, in many installations a laminagraph is not available.

For some time, we have been using the anteroposterior lordotic position when special study of the lung apices is desired. This is a simple method and requires no special apparatus. The examination may be done rapidly and with the use of only one 10 × 12-in. film. The patient faces the roentgen-ray tube (Fig. 1) and, with the knees slightly bent and the abdomen protruding in extreme lordosis (Fig. 2), leans backwards against the cassette holder. The central ray is directed hori-

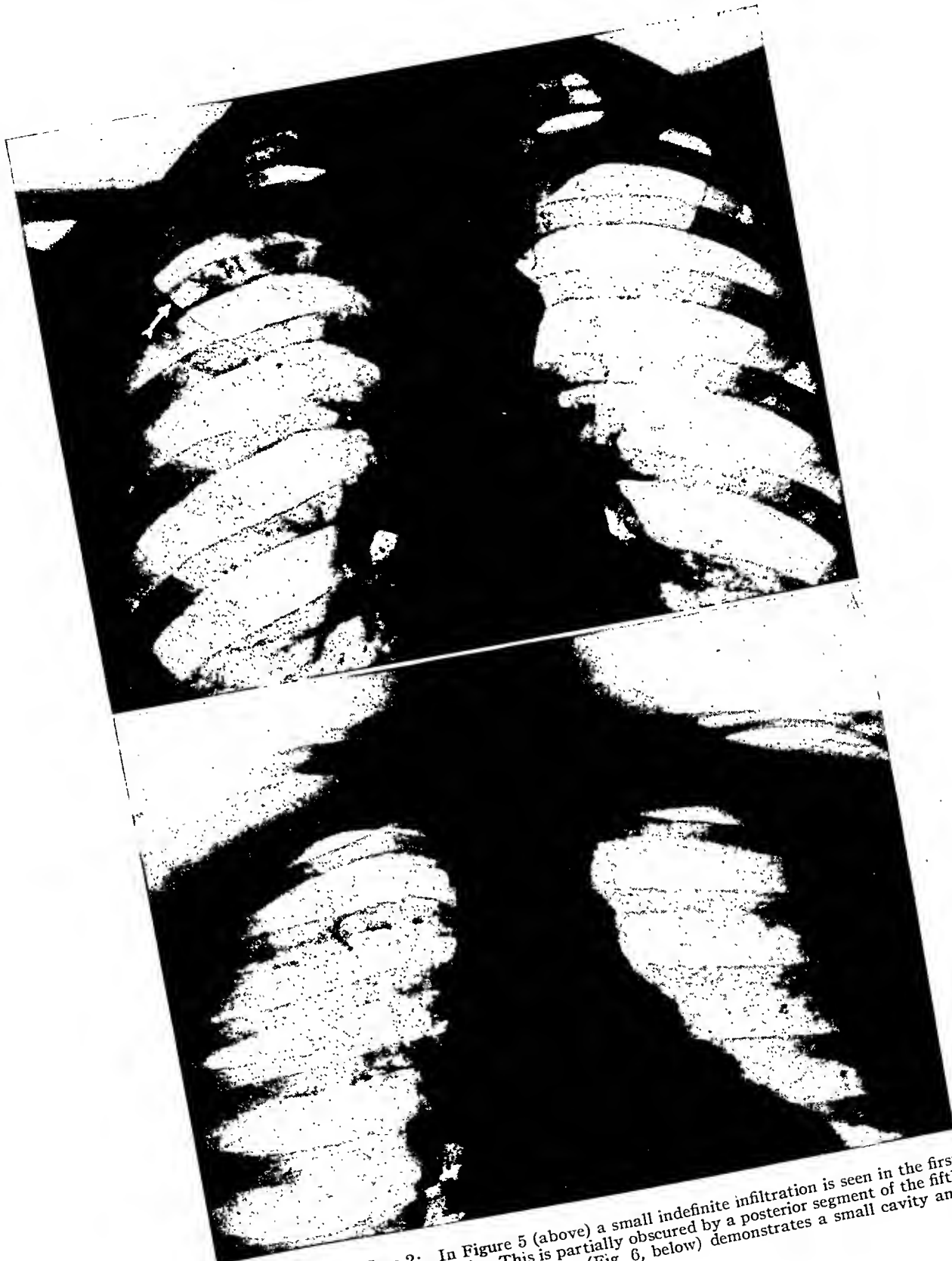
zontally. The technical factors used are such that the exposure is twice that for the routine postero-anterior projection at 6 feet; or the same factors are used as in the ordinary examination and the distance is decreased to 4 feet. The lordotic position causes the clavicles to be projected upwards while the anterior portions of the ribs assume an approximately horizontal position.

It is true that small lesions situated in the most anterior portion of the upper lobes may be displaced and distorted unduly. We have, therefore, on occasion used other projections to demonstrate anterior lesions. In most of the cases examined by us, however, the anteroposterior lordotic projection has proved adequate.

This projection has been most useful and strikingly demonstrative in those cases in which there is only a suspicion of a shadow behind the clavicles or of an in-



Figs. 3 and 4. Case 1: In Figure 3 (above) there is a faint suggestion of several small infiltrations just beneath the mesial end of the right clavicle and within the shadow of the anterior extremity of the first rib. Figure 4 (below), the anteroposterior lordotic projection, shows infiltrations and a small cavity containing a fluid level (arrow). Notice the projection of the clavicles above the pleural domes and the horizontal position of the anterior extremities of the upper ribs.



Figs. 5 and 6. Case 2: In Figure 5 (above) a small indefinite infiltration is seen in the first right anterior interspace (arrow). This is partially obscured by a posterior segment of the fifth rib. The anteroposterior lordotic projection (Fig. 6, below) demonstrates a small cavity and several small adjacent infiltrations.



Figs. 7 and 8. Case 3: Routine film (Fig. 7, above) shows an infiltration obscured by the anterior portion of the left second rib and posterior portion of the fourth rib. Its ring shape suggests a cavity (short arrow). There is a faint suggestion of a shadow behind the anterior end of the first rib, obscured by the posterior portions of the third and fourth ribs and the mesial end of the clavicle (long arrow). The lordotic projection (Fig. 8, below) shows a large nodular lesion in the apex (long arrow) and also the cavity which was partially obscured (short arrow).



Fig. 9. Case 4: Bilateral tuberculosis. Status of right apical cavity not clearly determined. Apical adhesions are demonstrated.

filtration which is incompletely discerned. In Case 1 there was a suggestion of an infiltration in the right apex (Fig. 3). The lordotic projection (Fig. 4) demonstrated a definite cavity showing a fluid level and several small adjacent infiltrations. After the induction of pneumothorax therapy in this case, the lordotic projection was of great aid in following the course of the disease. In Case 2, a small infiltration was noted at the level of the first right anterior interspace (Fig. 5). The use of the lordotic projection (Fig. 6) demonstrated the lesion to be a small cavity with several small adjacent infiltrations.² In Case 3, the routine film (Fig. 7) showed an infiltration obscured by the anterior portion

of the left second rib and posterior part of the fourth rib; there was a suggestion of another lesion obscured by the anterior end of the first rib and the posterior parts of the third and fourth ribs. Films taken in the lordotic position (Fig. 8) showed a small cavity at the level of the second left rib and, in addition, a large nodular infiltration in the apex of the lung. In Case 4, a cavity was demonstrated in the right apex and in the left lung. After induction of a pneumothorax on the right side, the apical region of the right upper lobe was obscured and the status of the cavity could not be determined (Fig. 9). The lordotic examination clearly indicated that the cavity was still not collapsed (Fig. 10).

It has been suggested that slight over-exposure of the film may bring out lesions which may be obscured on the roentgeno-

² The lordotic examinations were done on the same day or the day following the routine examination with the 14 X 17-in. film.



Fig. 10. Case 4: Right apical cavity with fluid level clearly outlined and band adhesions clearly discernible.

gram made with the usual technic and that, if this practice were pursued in cases such as those mentioned in this paper, further examination using the lordotic position would be unnecessary. This is only partially true, since it is unlikely that the details of such lesions will be demonstrated if the obscuring shadows of the anatomic structures projected into the pulmonary apical region are not displaced. This can be accomplished only by means of the lordotic position or its modifications.

SUMMARY

The anteroposterior lordotic projection for the examination of the pulmonary apices is described. It is extremely useful in the detection and identification of small or inadequately visualized lesions in the

apex of the lung. Several cases illustrating its value are presented.

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Neurosurgery and Radiation for the Relief of Pain in Advanced Cancer¹

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ONCE A SUFFERER from a malignant neoplasm is referred to a roentgenologist, the latter should make the patient's future course a matter of constant concern. Particularly in the case of recurrent or metastatic growths, the important role played by radiation results in great dependence upon the radiologist for help and advice. This group of patients is one of the roentgenologist's greatest responsibilities and deserves his most considered judgment that no measure be overlooked that may prevent suffering and early drug addiction.

Sometimes the attitude toward metastatic cancer is unduly pessimistic. There is an inclination to put the patient on morphine and hope that the tumor will do its work quickly. We do not know enough about cancer to predict with any degree of certainty which tumors can be controlled. Percentage figures do not apply to the individual case. A patient with a controlled neoplasm, metastatic or not, is no more ready for the grave than a patient with controlled diabetes or a failing heart. Cancer, when there is any hope of amelioration, should receive enthusiastic attention and adequate radiation. Frequent good and occasional startling results follow. Bone regeneration and relief of pain and other symptoms may ensue, with comfortable life for months and sometimes years.

CASE I: In June 1933, H. J. G., a 63-year-old white carpenter, came to the University Hospital because of a small mass in the right scrotal sac. He had first noticed this fifteen months previously and it had been growing larger for two months. A right epididymo-orchietomy with high amputation of the cord was performed promptly. The pathological study revealed an angio-endothelioma of the

spermatic cord, and the amputation was through involved tissue. A course of x-ray therapy was given through portals covering the entire spine.

The patient led an uneventful life for over two years, at the end of which time pain developed behind the right eye, followed rapidly by diplopia, loss of vision, and proptosis. A clinical diagnosis of metastasis was made, and radiation was tried. Prompt recession of the eyeball and relief of pain followed, with gradual restoration of vision. The patient resumed his carpentry and a more active life than most men of 65 engage in. He is now 73. In spite of direct irradiation of the eye, it functioned normally until cataract formation set in. There is an early cataract in the left eye. The radiation, no doubt, hastened the development of the cataract in the right eye, but there has been no recurrence of tumor.

CASE II: J. M. B., a 36-year-old white housewife, mother of two children, had a radical mastectomy for breast carcinoma, followed by radiation therapy in the fall of 1932 at another hospital. Three years later, she was admitted to the University Hospital, incapacitated by severe pain in the left shoulder girdle and arm. The shoulder was greatly swollen. Motion was sharply limited and the arm useless. Even passive motion produced agonizing pain. All this had developed rapidly during the previous three months.

X-rays (Fig. 1A) showed destruction of most of the left clavicle and scapula. An aspiration biopsy was done, with a report of "metastatic carcinoma."

Radiation therapy was started at once. Within three or four days, pain was completely relieved. Within two weeks, the patient had partial use of the left arm. A roentgenogram made a few weeks later (Fig. 1B) shows the remarkable result, in so far as bone regeneration is concerned. More satisfying was the complete change from a pain-ridden cripple to an active, healthy woman.

Three months later, the patient was again seen, with extensive destruction of the lumbar vertebrae. Radiation again restored her to normal activity. From December 1935 to April 1939, this patient had one skeletal metastasis after another. Almost every bone, including the skull, was involved at some time. As the months and years went by, response to radiation became less dramatic, but until April 1939 she cared for her home and family. Four years and four months of active life were given her. By April 1939, active metastases were so widespread and the tumor so resistant that nothing more was attempted and death occurred three months later.

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

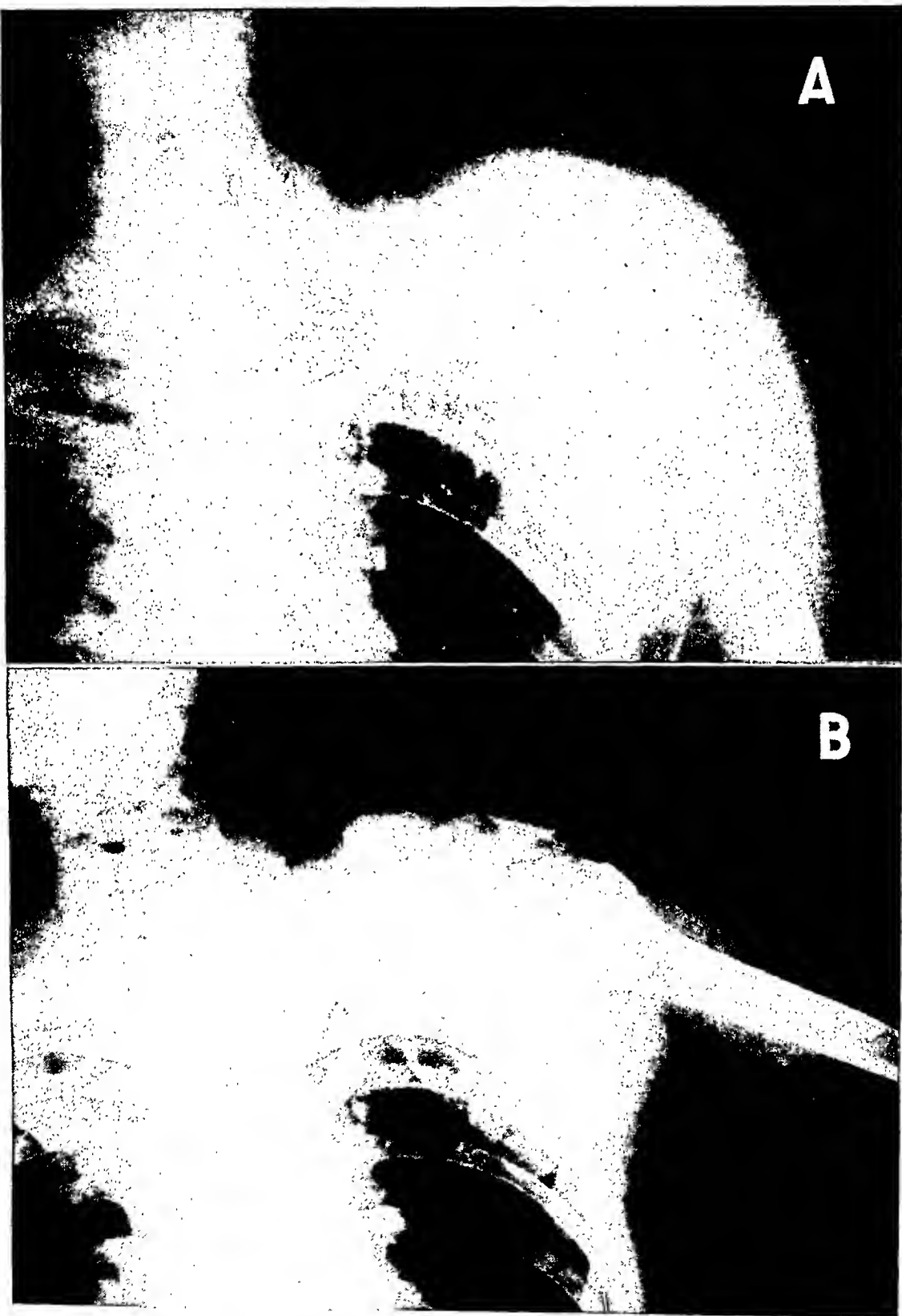


Fig. 1. Case II. A. Destruction of left clavicle and scapula by metastatic cancer. B. Bone regeneration following irradiation for relief of pain.

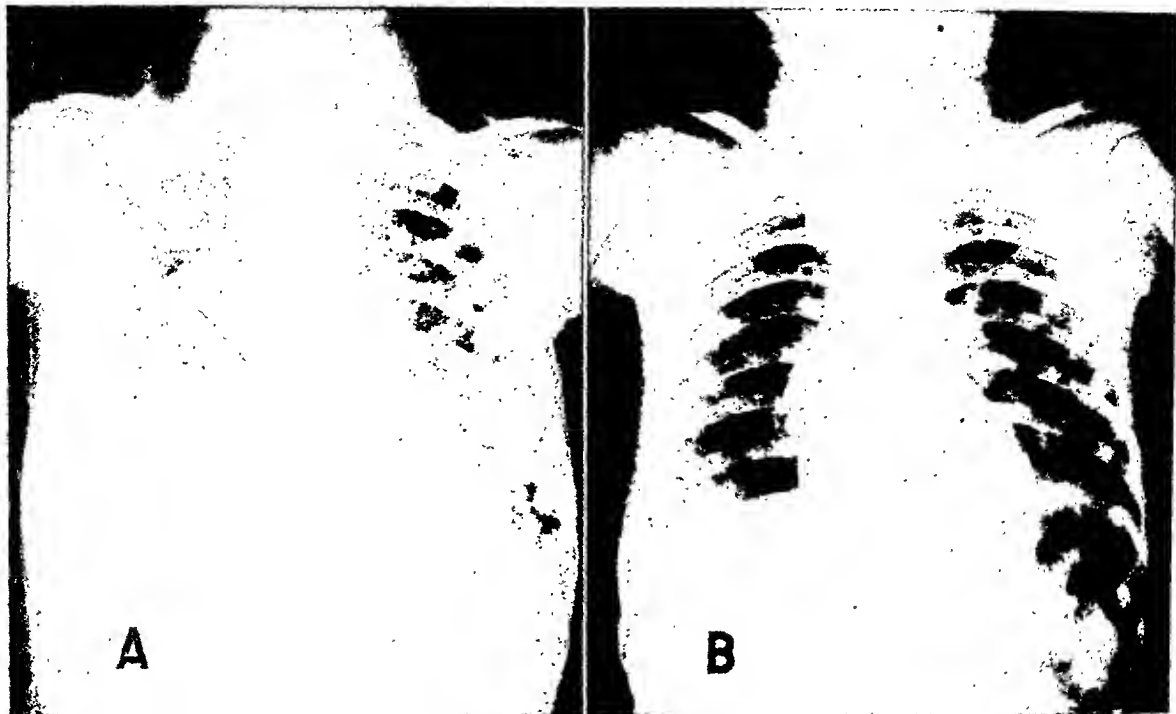


Fig. 2. Case III. A. Extensive pulmonary metastases from an atypical Ewing's tumor. B. Clearing of lungs following irradiation.

In connection with this patient, it should be pointed out that it is the roentgenologist's responsibility to see to it that the orthopedist is called in when bone metastases have produced danger of pathological fracture. Caution in the use and handling of the weakened parts and the application of supporting braces can prevent fractures of the extremities and crushing deformities of the spine until radiation has had its effect.

CASE III: This is the most remarkable case history in our records. In July 1932, the parents of a 6-year-old white girl, D. S., brought her to the Out-Patient Department because of the presence of a tumor of the chest wall. This tumor was in the right nipple line over the seventh and eighth ribs, it had been present three months and was then 2.5 inches in diameter and growing rapidly. It was slightly tender. The child was restless and sleeping poorly.

X-rays (Fig. 2A) showed the lungs riddled with metastases and an area of destruction in the right seventh rib, marking the site of a primary bone sarcoma. A biopsy of the mass (later reviewed by Doctor Ewing) was the subject of much discussion. Finally a diagnosis of an atypical Ewing's tumor was decided upon.

At the time of the child's first visit, it was felt

that the disease was too advanced for irradiation, and she was sent home without treatment. Ten weeks later, the parents brought her back. The external mass had reached a diameter of 6 inches and the child was *in extremis*. She had a high fever, rapid, thready pulse, and was cyanotic and cachectic. Hating to dismiss the parents without doing anything, we gave two doses of 600 r on successive days to the entire thorax and sent the child home to die. To our utter astonishment, she walked into the hospital with her parents five weeks later, a vigorous, healthy child. Figure 2B shows what had happened. Two more x-ray treatments of 600 r were given.

This patient is today a perfectly normal young woman and has been married a year. Figure 3 is a reproduction of her latest chest plate. The rib deformity is the only residuum of her disease.

Persistent pain in a patient with a known malignant neoplasm should be regarded as evidence of metastasis, whether it can be confirmed by roentgenographic evidence or not. Pain due to metastasis frequently precedes demonstrable changes. X-radiation at this point alleviates suffering and prevents deformity due to bone destruction. Other possibilities can be investigated during the period of roentgen therapy. Waiting to irradiate until de-

struction has taken place simply prolongs the period of suffering for the patient and increases the chances of pathological fracture.

CASE IV: W. M. T., a 35-year-old white housewife, had a right radical mastectomy done elsewhere in February 1935 because of a breast cancer with axillary and supraclavicular metastases. She was referred to our department for postoperative x-ray therapy. A routine course was administered to the local areas, and x-ray sterilization was done. (We believe that there is definite evidence that sterilization is beneficial, at least in some cases, but as of the present we prefer surgery for this purpose, on account of the possible interstitial-cell reaction, which is unaltered by radiation.)

The course was uneventful for three and a half years. In July 1938, the patient began suffering with pain low in the lumbar region. X-ray examination was negative for metastases. Her physician then decided she was suffering from arthritis, and a hunt for foci of infection was started. Within three weeks, the pain had become rapidly worse, and x-ray treatment was given to the lower lumbar spine, on a presumptive diagnosis of metastasis. Relief was prompt and complete. Two months later, the patient was back with pain in the upper lumbar region and cervical spine. On this occasion, bone metastases were found in the body of the twelfth thoracic vertebra and several cervical bodies. The lumbar spine was still negative. Undoubtedly, the lower lumbar pain had been due to metastasis, the progress of which was aborted by radiation before bone destruction developed. We could have saved this patient three weeks of pain if we had insisted on irradiating the lower lumbar spine when she began to complain. Three weeks less of pain would have meant a great deal to her. We were able to control the cancer for only a few months. Pulmonary metastases as well as extensive skeletal metastases developed and death ensued, after much suffering, in a year.

In the fight against pain due to advanced cancer, the radiologist and surgeon have a valuable ally in the neurosurgeon. His help should be sought promptly. The relief afforded by nerve injections, root sections, and cordotomies is dramatic. These measures are not, of course, applicable to all patients, and they carry a certain risk. The decision as to which procedure, if any, should be undertaken rests with the neurosurgeon, but the roentgenologist must see to it that his patients have the benefit of proper consultation whenever he thinks there is a chance of help from another

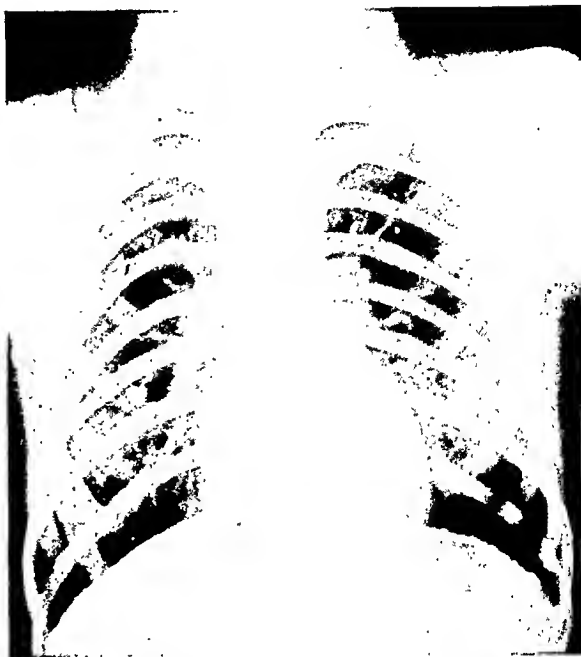


Fig. 3. Case III: Patient shown in Figure 2, thirteen years later.

quarter. Obviously, a patient who has only a few weeks to live should not be subjected to useless surgery of a fairly radical nature, nor should an elderly person whose pain can be controlled by small amounts of opiate undergo the hazard of operation. Often the decision is a difficult one, but it would seem preferable in doubtful cases to proceed with surgery, for there is so much to be gained and comparatively little to be lost.

CASE V: W. M. O., a 75-year-old white man, presented himself in March 1943, with an extensive carcinoma of the tongue (epidermoid, grade III). The tumor had been present for nine months. It was a bulky growth involving the entire tongue; there were metastases in the regional nodes, and the patient was suffering agonizing pains in the tongue and left side of the face, jaw, and neck.

X-ray therapy resulted in only partial relief of pain. The nodes melted away and the tumor was reduced by one-third, but it was still too extensive for radium implantation.

On July 9, 1943, the mandibular branch of the left fifth nerve was injected with novocaine and 1 c.c. of alcohol. A second injection was necessary several days later because of reappearance of pain in the auriculo-temporal branch of the mandibular nerve. A perfect result followed. Sectioning of the nerve root was therefore attempted, but the patient reacted badly to anesthesia, and the procedure could not be completed. However, though

the tumor is again growing, he is still comfortable three months later and does not require any medication for pain.

CASE VI: R. W. C., a 50-year-old white man, was referred to our department from another community for irradiation of a thoracic tumor. Exploration of the right thorax two weeks previously had revealed a large mass arising from the right side of the mediastinum and adhering densely to the second, third, and fourth vertebrae and ribs posteriorly. The operator felt that the tumor was too vascular for biopsy, so a pathological diagnosis was never made. The patient was suffering with severe pain just below the right nipple. In hope that the tumor was radiosensitive, x-ray therapy was administered. There was no response in six weeks. Therefore, the posterior roots of the right second, third, fourth, fifth, and a portion of the sixth thoracic nerves were divided intradurally. Relief of pain was complete. The patient lived only three months, but without suffering.

CASE VII: S. K., a 47-year-old colored man, when first seen in September 1938, had been passing bloody urine and clots intermittently for six months and had been bleeding continuously for six weeks. Cystoscopic examination revealed flat tumor fronds around the internal urethral orifice, a small sessile tumor in the center of the trigone, and a large papillary tumor near the left ureteral orifice. The tumors were resected and fulgurated. The pathological report was papillary carcinoma, low grade I.

During the next few months, recurrences were resected and fulgurated at monthly intervals. Since he was comfortable and had no bleeding, the patient refused further attention for a year. When he began passing blood again, he returned. Multiple tumors were removed. Still stubborn, the patient stayed away twenty-one months, until more blood appeared in his urine. This time, the bladder walls were packed with small papillary tumors. One was removed for examination. The pathological report was still epidermoid carcinoma, low grade I. As resection and fulguration were impractical, deep x-ray therapy was tried. Because of the low grade of the tumor, irradiation was carried to the limit of tolerance, 18,000 r in air being given in a

ten weeks' period. In two months, intractable pain had developed in the left hip and down the lateral aspect of the thigh to the ankle. From the subsequent course, it is fairly certain that fibrosis around the sacral plexus, secondary to the intensive irradiation, was the cause of the pain, rather than metastasis, though the latter was suspected at the time. The neurosurgeons were called in, and they did a laminectomy of the third and fourth thoracic vertebrae, incising the anterolateral column of the cord at two levels. Relief of pain was complete. This was in February 1942. At cystoscopic examination in March, only two small tumors remained in the bladder. These were fulgurated. The patient has learned his lesson and comes in regularly for check-ups. Every month or two another recurrence is resected and fulgurated, and he is getting along nicely.

When considering the advisability of neurosurgery, the possibility of unpleasant results must be weighed. Loss of sensation, loss of sphincter control, and paralysis are ever present dangers, and the pain should be more difficult to live with than the possible complications before they are risked.

CONCLUSIONS

1. Advanced or metastatic cancer is not a signal to bring on the opium and abandon hope. A few tumors can be arrested indefinitely, some for years or months, and many patients can at least obtain relief of pain from irradiation or neurosurgery.

2. Pain, whether metastasis is demonstrable or not, is an indication for radiation in patients with a known malignant tumor.

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The Ureter and Its Involvement in Pelvic Irradiation¹

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THE URETER MUST be considered a vital structure. Its damage often results in a life-taking series of events. When total ureteral obstruction has existed for more than a few weeks, irreparable injury to the kidney results. If both ureters are involved and operative drainage of the urine is not quickly provided, the patient's life will be sacrificed.

The writer claims no originality in discussing the ureteral complications of irradiation therapy of the uterine cervix. Among others who have dealt with the subject are Herger (1), Schmitz (2), Bugbee (3 and 4), Matusovszky (5), and Colwell (6). The animal experiments of Martin and Rogers (7 and 8) indicate how seriously the ureter can be affected by doses of radium that appear to be small compared with a cancer dose, though the time factor in their studies was, of course, relatively short.

While the literature on ureteral-renal injury would seem to prove that it is both frequent and serious and is recognized as such by many close observers, little has been published on ways and means of controlling the lethal effects of such damage secondary to irradiation of the pelvis. When a patient with a pelvic cancer or fibroid is referred or comes directly to the radiologist for therapy, we may ask the question: "Who is responsible for the after-care of the case, when the x-ray or radium treatment has been concluded?" Since conditions related to the work of the radiologist may develop later, it would seem to be his duty to keep the patient under observation for a long time. It is his responsibility to anticipate all possible post-irradiation effects and to care for these personally or see that proper treatment is

carried out by others. The need for such after-care is believed to be frequent.

As an example, mention may be made of a patient under the writer's care at the present time, with moderate obstruction of both ureters following treatment of a uterine fibroid four years ago. The fibroid, when treated, was about the size of a three months' pregnancy. The patient refused surgery, and the pelvis was irradiated with a total skin dose of 3,000 r delivered through several ports. Menorrhagia ceased and the tumor was reduced in size. At the present time a check-up of the patient shows a blood pressure of 160 systolic and non-protein nitrogen 42 mg. per cent. A No. 6 catheter is a tight fit for the ureters, but it is expected that dilatation will produce improvement. In this case the shrinking fibroid has probably caused extrinsic pressure on the ureters. The x-ray dose given would hardly seem sufficient in itself to produce any injury.

In some cases the ureters are already being compressed mechanically by the growing neoplasm before treatment is begun. Rarely cancer may actually invade the ureteral wall. Usually the ureter is caught in the healing fibrosis after intensive intrapelvic irradiation. That obstruction of greater or less degree often follows surgery in the deep pelvis is well known. A paper on this subject, therefore, seems timely both for the purpose of creating helpful discussion and also of suggesting a routine which has been successfully used by the author.

It is doubtful if surgeons make a practice of checking the ureters after pelvic operations involving trauma close to the ureterovesical junction. It is probable, however, that serious interference with the patency of the ureters follows treatment of cervical cancer with radium far more often than it follows surgery in the same area. Pohle

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

writes: "In taking care of patients afflicted with carcinoma of the cervix, particularly the more advanced cases, one should always remember that the natural termination is usually due to uremia from occlusion of the ureters."

At times, some ureteral obstruction will be found by routine cystoscopy and catheterization before treatment is instituted. If this obstruction is due to pressure by the tumor, treatment designed to reduce the mass may relieve the block. While this would seem natural, it rarely happens. It is felt that stricture of ureters in radium-treated cancer of the cervix is due rather to compression by scar tissue than to actual contracture of the ureter itself. The ureter lies, rather loosely, directly under the peritoneum. It is easy for a centralized area of scar tissue in the prevesical area between the ureters to draw them together at this point. The surrounding scar tissue, exerting pressure centrally on each ureter, closes its lumen. In a case to be described below, an autopsy showed this actually to have taken place. When the fibrous band about the ureters was cut, a fairly good opening was found through each, though some fibrous contracture had taken place within the walls.

Taking this matter of the possibility of ureteral-renal complications more seriously and adopting a routine after-care will result in an encouraging reduction in the mortality of radium-treated cancer of the cervix. We must admit that in recent years published statistics of adequately treated cervical cancer have not shown much further lowering of mortality. It would seem proper to suggest that we can perhaps improve those statistics by preventing some of the deaths which are due to uremia and associated conditions following pelvic irradiation. It is stated that many such deaths are occurring and that frequently nothing has been done to prevent post-irradiation ureteral obstruction. Of treated patients who do not survive five years, how many die with a ureteral injury as a primary or contributing factor?

Inquiry has led to the impression that

routine cystoscopic and pyelographic studies of these patients, with subsequent treatment, are seldom done. In some instances the patient is followed for a few months subsequent to the treatment course. The condition of the vagina and the skin is noted, and that is all. Unless the patient gives a typical history of ureteral obstruction and renal colic, she is dismissed.

Patients vary greatly in their interpretation of symptoms. Cases of ureteral obstruction may go on to uremia without the classical backache and radiating loin pains we have been told should first be observed. The fact is that a slowly occurring ureteral obstruction is often symptomless until uremia has developed, when it is usually too late to save the patient's life. Such a case was the cause of the writer's perhaps unusual interest in this complication.

A woman of 43 presented herself with a cervical cancer of squamous-cell type, grade 2, stage 2, arising in a cervical tear on the left. Her general health was excellent. Deep x-ray therapy through five ports was instituted. Doses of 500 r divided between two ports were given daily until a skin dose of 8,000 r had been administered (Thoraues filter; 200 kv.). Within seven days the cervical lesion was clearing up and within ten days radium therapy was begun. Fifty milligrams of radium element, filtered through the equivalent of 1.0 mm. platinum and 1.0 mm. rubber, was applied: 10 mg. within the fundus of the uterus, 20 mg. within the cervical portion, and 10 mg. within each vaginal fornix. A total dose of 7,674 mg. hr. was thus given.

The woman was examined several times following completion of the irradiation. The external skin showed only a moderate reaction. The cervical cancer melted away and the usual resolution took place. The cervix became obliterated and the vaginal fornix contracted, as usual, with moderate redness. There was very little pelvic pain or cystitis. For perhaps six weeks there was a mild enteritis, which responded to a low-residue diet and sedative medication with bismuth and paregoric.

After the eighth week the patient made no further complaint. At the end of nine months, without any history of backache, loin pains, or bladder disturbances, she began for the first time to complain of headache. In seven days nausea developed, and the patient was hospitalized for study. The non-protein nitrogen was found to be 73 mg. per cent and the urinary output was greatly reduced. Cystoscopy showed the bladder to be moderately red, as in many women in the menopause. The ureteral orifices were easily found and catheterization was

attempted, only to meet with a solid obstruction at about 3 cm. The left ureter would not even take a filiform, but after some effort a No. 5 catheter was passed on the right. This was left in place for twenty-four hours—after which it became blocked, as usually occurs—and 500 c.c. of urine was obtained. The catheter was then removed for cleaning and it was impossible to reinsert it. The patient was treated by sweating and the usual measures for uremia. The non-protein nitrogen increased to 90 mg. per cent within twenty-four hours and a surgical consultant advised against operation. Death occurred within three days with a non-protein nitrogen of more than 150 mg. per cent. The patient's husband stated that, until ten days before her death, she was doing all her own housework and appeared to be very well.

Autopsy showed moderate distention and cloudy swelling of both kidneys. The ureters were moderately dilated and patent down to the cervical area. At this point they were drawn together into a firm rounded mass, 3 cm. in diameter. This mass was removed and sectioned. No cancer cells were found within it, nor was there any involvement of the adjacent lymph nodes.

The total lack of symptoms of ureteral block in the foregoing case, until uremia had developed, caused the writer to investigate a number of other cases recently treated. As a result, a program of ureteral care and observation was set up which has been followed since that time. The absence of a urologist made it necessary that the urological work be done by the writer. No doubt many others, under war conditions, will find it necessary to do likewise, especially as the frequency with which the urological observations should be made renders it impractical to send the patients to some distant urologist. In the writer's case the desire to work out the problem for himself was an added incentive. The routine technic is as follows.

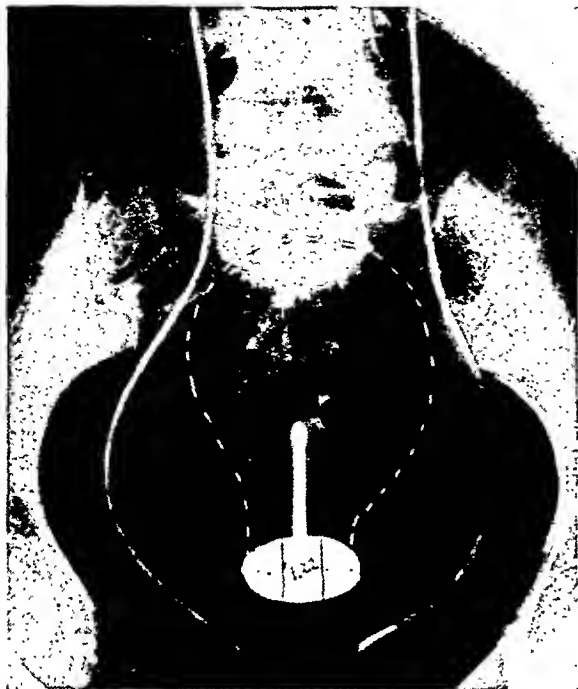
TECHNIC FOR MAINTENANCE OF URETERAL PATENCY

No particular preparation of the patient is necessary except a sedative (3 gr. nembutal) an hour before cystoscopy.

The urethra and introitus are painted with mercurochrome. The cystoscope is well greased with nupercain ointment, dipped in glycerin, and inserted. At times preliminary dilatation of the urethra with

graduated sounds is done. It is believed that application of nupercain ointment to the catheter makes it slip along with less trauma and gives some sedation. Though both ureters are often checked at the same time, only one catheter is ever left in for any length of time. Some ureters swell after the catheter is withdrawn, and having both closed off even for a few hours is an unpleasant experience. Usually an opiate, hypodermically, is needed following cystoscopy. A bottle of coca-cola is given to encourage diuresis. With the catheter in place, the patient is kept on an out-of-the-way clinic table for two or three hours and then sent home, walking at least to the waiting car or taxi. Sulfathiazole, 15 gr. t. i. d., and a few sedative tablets are routinely given. Occasionally, but not often, a hypodermic is needed after the patient reaches home. By this plan the cost of hospitalization is kept down, which is often of great importance.

As a result of this routine, it has been possible to keep the ureters open in almost all cases. The preliminary cystoscopy and pyelography give useful information about the bladder and the pre-irradiation condition of the urinary tract. This may be of great help in subsequent follow-up cystoscopies. It is felt that when the ureters are within normal limits in the first place, they can be kept open. If a stricture is allowed to develop that will not admit a No. 6 catheter, the trouble is serious. The ureter may be *kept open*, but it cannot be opened up after it has once been allowed to become smaller than this. When the reduction of the lumen passes this point, the catheters become plugged up when left in and, because of their small size, tend to stick into the ureteral wall and cause additional trauma. Such trauma will defeat the primary purpose of catheterization—*i.e.* opening up permanently the partially closed ureter. With the use of sulfathiazole routinely as a prophylactic agent, infection has been uniformly absent. Forty-five grains daily is given for the first three days, then half this dosage for the next three days. Unless the case is



Film 1. Typical female pelvis with ureteral catheters and pessary and lead disk in place. The approximate position of the uterus is indicated in this and succeeding films by a broken line.

complicated by a previous infection, this is usually sufficient. Increase in fluid intake is advised. In cases showing little or moderate obstruction, the intervals between catheter dilatations may be six weeks or longer during the first year. In most cases the procedure has been about as follows: primary cystoscopy and ureteral calibration during the first three weeks of irradiation, with dilatation if required; repetition of cystoscopy after successive intervals of six weeks, four weeks, eight weeks, and three months, with final cystoscopy, if things seem to be going well, at the end of the first year after treatment.

After considerable experience, it has been found that when the ureter is snug for a No. 6 catheter or tight for a No. 7, less trauma and better end-results are obtained if, instead of using a No. 7, a No. 6 is built up with melted wax over a distance of about 4 cm. some 18 cm. from the tip. In this way the entire ureter is not greatly disturbed and the actual dilatation is confined exactly to the strictured area, which begins 2 cm. inside the vesical orifice.

This may appear to be a lot of work, but with proper set-up it should not be burdensome. After all, what is the use of irradiation if the patient is to be lost through failure to prevent complications? In the average case about fifteen minutes is required for the cystoscopy. A nurse can handle the case after that. Pyelography takes a bit longer, but is done only once, at the beginning. Arrangements are usually made for some friend or relative to see the patient home. In cases in which serious ureteral obstruction is found, hospitalization is, of course, required for a few days. In actual practice, the writer has seldom found this necessary.

One warning should be repeated, as it is of the utmost importance in this work. *Do not wait for symptoms of ureteral block to appear before doing something to prevent the same.* It is comparatively easy to keep the ureters open but quite another problem to open them up after stricture is established. The ureter is a delicate structure, and the trauma from very small catheters, when these are all that will pass, is vastly greater than the trauma when a fairly large whistle-tipped catheter can be inserted. The early primary cystoscopic catheterization is important. It is believed that the catheters should be left in a few hours even when the ureters are found to be normal in size, to help straighten them out. This makes subsequent catheterization easier, when mild degrees of contracture in the ureters, rather than their natural curves, may have to be overcome.

Cystoscopy and repeated ureteral catheterization call for fortitude on the part of the patient, as well as co-operation. It has been found, however, that patients will co-operate when the importance of this measure is explained to them. Every woman has a horror of a cancer death. It may be that if we took more time to explain to our patients what they are up against, and what we are trying to do for them, they would always co-operate.

The author has made film studies of the ureters in a considerable number of women. Most of these studies have been incident



Films 2 and 3. Right and left oblique views of pelvis shown in Film 1.

to cancer of the cervix. They suggest that the pelvic portions of the ureters show very little deviation in relation to the cervix.

For these studies an aluminum stem pessary, over which was fitted a thin lead disk measuring exactly 3 cm. in diameter, was inserted into the cervical canal with the face of the disk against the face of the cervix. Examination by the finger and speculum, after several such placements, showed the disk wall in place after the films were made. Usually light packing was used to insure the disk remaining in position, but no notable difference was noted in the same pelvis, with or without packing. Most pathological cervixes have largely lost their normal mobility anyway. The radiographic measurements indicate that in most women the ureters lie within 1.5 to 2.0 cm. of the rim of the cervix.

Film 1 is that of a typical female pelvis with ureteral catheters and the cervical measured disk and pessary in place. The wide swing of each ureter as it enters the

pelvis is shown, as well as the approach closer to the cervix as the ureter swings back toward the midline and starts forward to the floor of the bladder. The face of the pessary, which as before stated measures exactly 3 cm. in diameter, has been divided into three parts. Each third, as a measured distance on the film, represents 1 cm. fairly accurately. The cervix lies immediately cephalad or against the cephalad side of the measured disk. It is readily seen in this view that the cervix is within 2.0 cm. of the ureter.

Film 2 was taken in the right oblique position. The more distant ureter of the two is within 2.0 cm. of the rim of the cervix. Effort is now being made to see how far the ureters can be thrown away from the cervix, as represented by the metal disk. Film 3 is taken in the left oblique position. On this film the more distant of the two ureters is approximately 2.5 cm. from the rim of the cervix.

Film 4 and 5 are of a different case.



Films 4 and 5. Oblique views of another pelvis, showing ureters closer to the rim of the cervix.

Only oblique views are shown. It was found that the oblique positions usually show the ureters farther away. It will be noted in this case that they are closer to the rim of the cervix than in the patient shown in Films 1-3.

Film 6 is one of the many lateral views studied. In this position one may see how the ureters, after dropping off the sacral promontory into the pelvis, suddenly rise at the level of the cervix, travel anterior on each side of the cervix to the bladder floor. The sharp angulation of the ureter, shown on this film, no doubt adds to the difficulty of passing the catheter through this area, when pathological stricture has occurred following irradiation of the cervix.

Mention has been made earlier in this paper of the desirability of early catheterization, to "straighten out" the normal angulation of the lower ureter. Film 6 shows the angulation referred to. It is thought that the size 6 or larger catheter, which has enough body to offer some

definite resistance to angulation, helps to loosen up the severe angulation at this point when left in place for a few hours.

It must be realized that the normal ureter all along its course has a certain degree of mobility, as it lies directly under the peritoneum. The measured cervical pessary used in taking these films is magnified on the films in the same proportion as the adjacent anatomical structures. It would seem reasonable to assume that the distances, in centimeters, at the level of the cervix, as shown in these film studies, are fairly accurate. The approximate shape and position of the uterus have been indicated in the film by an interrupted line.

A word may be added regarding the procedure after it has been found that one or both ureters are irreparably blocked in the area of the cervix. If one ureter alone is involved, while the other shows unimpaired patency with normal kidney function, and sufficient time has been allowed to indicate that no further narrowing of

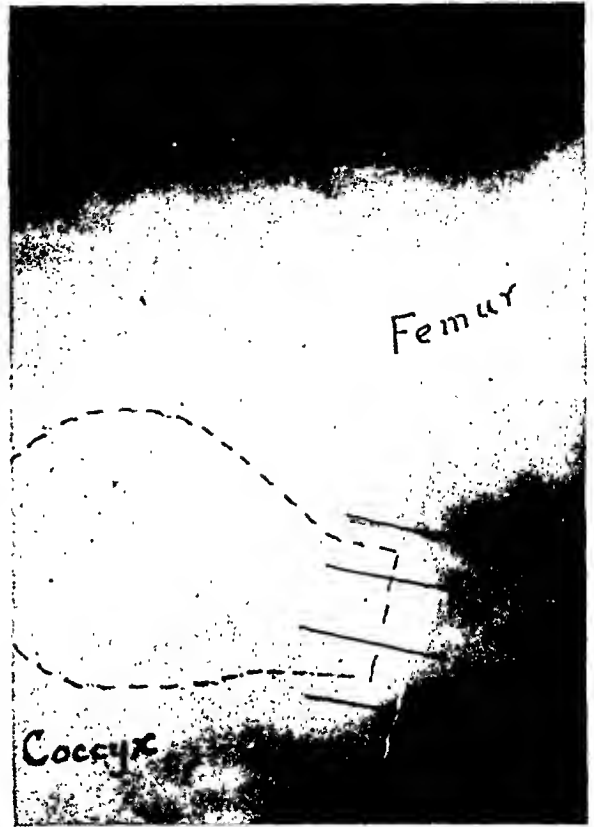
the good ureter is probable, a nephrectomy on the involved side is indicated. If both sides show more or less involvement, so complete on one side that marked impairment of function has resulted, and dilatation has not helped, then the more severe side may be surgically treated by bringing the ureter out through the abdominal wall. It is said that recent improvements have made such a permanent drainage of urine fairly comfortable for the patient.

It must be realized that three or four weeks of complete obstruction will permanently ruin the average kidney. Some surgeons have cut the ureter at the point of pelvic obstruction and transplanted it into the bladder. This is admitted to be a difficult procedure. In discussing this question with genito-urinary surgeons, I have been told that the transplantation of the ureters in the prevesical area, before irradiation, though desirable, would be a very difficult matter. Further advances in surgery may perhaps solve this problem for us. At present it would seem that surgeons should be consulted as soon as serious obstruction has been found to exist, to the end that the affected kidney and the patient's life may be saved. Perhaps the earliest and safest procedure at present is to sever the totally obstructed ureter at the point of obstruction in the pelvis and bring the severed end out of the abdominal wall for permanent external drainage of the urine. If such a surgical procedure is done early enough, it may prove life-saving.

SUMMARY AND CONCLUSIONS

1. Ureteral obstruction must be assumed as a definite hazard in the treatment of cervical cancer by radium and x-rays. Literature on this subject and the personal observations of the writer would indicate that this is a frequent aftermath of heavy irradiation of the cervix.

2. It is believed that this hazard is not always realized by the radiologist and that adequate steps are not taken to prevent its occurrence, with subsequent death of the patient. Certainly we must doubt that this complication is generally known



Film 6. Lateral view showing sharp angulation of ureter.

to exist by the many physicians who rent radium for an occasional case and know little of the technical factors involved or the possible complications from its use. Even those who make radiology a specialty may at times forget this danger.

3. Ureteral damage is believed to be a far more serious and frequent complication of irradiation therapy of cervical cancer than bowel or bladder damage. Yet, in recent years, one has heard far more discussion of bowel damage and possible measures for combating it than of damage to the kidney and ureters.

4. It is hoped that this paper will stimulate further interest in the study of this complication. Improvement of our statistics of cervical cancer cures may be shown to result from a greater interest in preservation of ureteral patency and post-irradiation management.

5. Conclusion of the irradiation program should not conclude the interest of the radiologist in the case. Proper in-



Films 4 and 5. Oblique views of another pelvis, showing ureters closer to the rim of the cervix.

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The Development of Centralised Radon Services in Australia¹

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SINCE THE gamma rays used therapeutically are emitted by Radium B and Radium C, either of the parent elements radium or radon can be used as a source of gamma radiation. With the use of each, certain advantages and disadvantages are associated, but in general any national radium scheme (1, 2) has provided for both methods of treatment. In the majority of cases, the use of radon has been restricted to the type of applicator known as a "seed," intended either for permanent or temporary insertion in the tissues and usually characterised by short length and low filtration. Clinical experience with this form of applicator has not been particularly satisfactory, and a decreasing use of radon has been reported from several countries (3). It has been stated that the circumstances under which radon has been used have frequently been unsatisfactory, and the Radium Commission of Great Britain stipulated in 1939 that radon produced from national radium should be employed only in approved centres or under circumstances as carefully controlled as those in which national radium was used. From the records at its disposal, the Commission feared that radon prepared from other than national radium was frequently used by unqualified persons, who were without the auxiliary services by which the use of radon can be made safe, and who did not keep the accurate records which are required for all radiotherapy performed under the auspices of the Commission. It appears possible, therefore, that the unsatisfactory results in the use of radon have been due rather to the method of use than to any inherent disadvantages in radon itself.

The Australian National Radium

Scheme was inaugurated in 1928, when, on the recommendation of the Director-General of Health, the Commonwealth Government decided to purchase 10 grams of radium and to distribute this among Australian hospitals. At the inception, provision was made for radon to be made available, and its use has increased steadily throughout the continent. Additional quantities of soluble radium have become available until there are at present 3.66 gm. of radium used in radon production. It is believed that this increased use has resulted primarily from the manner in which the radon is mounted in containers, and that as a result it has been possible to develop centralised radon services which have important advantages. The purpose of this report is to trace the developments in the use of radon in Australia and to describe the manner in which the present centralised services are operated.

Radon centres were established in Melbourne and in Sydney in 1929, in Adelaide in 1930, in Perth in 1933, and in Brisbane in 1938. The Melbourne centre was situated at the original Commonwealth Radium Laboratory, established at the University of Melbourne by arrangement between the Commonwealth Department of Health and the University. The Department equipped, staffed, and maintained the Laboratory. In each of the other centres the radon laboratory was established at the local university by arrangement between the university and the local anti-cancer authorities, the Commonwealth making available the necessary soluble radium. Initially methods of purifying and mounting radon were determined individually by the authorities at each centre, and experience was thus gained of a variety of techniques. A considerable amount of investigation into various methods of purifying and mounting radon was carried out at the Commonwealth Labora-

¹ Accepted for publication in November 1943.

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TABLE I: TOTAL MILLICURIES USED FOR TREATMENT PURPOSES IN AUSTRALIAN RADON CENTRES

Year	Melbourne	Sydney	Adelaide	Perth	Brisbane	Total
1929	3,720	...	...	...	...	3,720
1930	11,919	...	...	...	...	11,919
1931	17,021	405	2,190	...	...	19,616
1932	14,008	1,096	2,335	...	...	17,439
1933	17,583	773	1,718	...	...	20,074
1934	21,960	...	2,013	...	...	23,973
1935	26,155	2,839	5,926	979	...	35,899
1936	28,055	6,476	5,988	782	...	41,301
1937	29,897	6,300	4,624	875	...	41,696
1938	29,695	7,857	...	1,922	6,966	46,440
1939	27,131	8,374	960	1,019	10,131	47,615
1940	27,700	7,981	6,897	563	7,912	51,053
1941	29,537	6,297	6,259	1,173	5,648	48,914
1942	39,751	8,413	4,134	864	4,359	57,521
1943*	20,632	4,987	2,061	358	3,917	31,955

* Six months only.

tory, and the various types of radon containers in use today were successively developed with the co-operation of practising radiotherapists. In 1935, efforts were made to have standardised procedures adopted throughout Australia (4) and, as a result, a definite impetus was given to the use of radon in all centres; this is illustrated by Table I, which gives the number of millicuries used annually for treatment purposes in the various centres.

Initially, the usual chemical methods of purifying radon were used, whereby oxygen and hydrogen were removed by sparking and passage over heated copper and copper oxide, and water and carbon dioxide were absorbed by phosphorus pentoxide and potassium hydroxide, respectively. These methods were slow, required the frequent replacement of chemicals which were contaminated with active deposit, and did not give a high degree of purity; radiation exposure of the personnel during purification was also considerable. In 1936, after extensive investigations in this Laboratory, a new equipment (5) depending upon physical rather than upon chemical methods was adopted, and similar equipment is now in use in Sydney, Brisbane, and Adelaide, while the Perth equipment includes many of its features. With this method, water and other vapors are removed by passing the mixed gases from the radium flask through a tube cooled with solid carbon dioxide; the hydrogen, oxygen, and helium are pumped off after the

radon and carbon dioxide have been condensed with liquid oxygen, and after evaporation the carbon dioxide is finally absorbed by heated potassium hydroxide. The time of purification has been reduced to one-half, the exposure of the operator to one-fifth, while the final purity of the radon is considerably increased. In a routine purification, a purity can be obtained such that from 60 to 100 mc. can be inserted in a volume of 1 cubic millimeter at less than atmospheric pressure and at room temperature; this corresponds to capillary filled with radon with a linear strength of up to 15 mc./cm. If the radon is condensed a second time, however, and the permanent gases and carbon dioxide are removed after each condensation, concentrations of up to 200 mc./cubic millimeter can be obtained.

At the beginning, the purified radon was sealed in thin-walled glass capillary, which was then subdivided into appropriate lengths, measured, and mounted in short platinum needles. This method had certain serious disadvantages:

(1) The glass capillary was fragile and easily broken in the laboratory, in the hospital, and in transit, leading to a definite risk to the personnel from inhaled radon, and to inadequate treatment of the patient.

(2) The subdivision of the glass capillary and the subsequent measurement and classification into strengths was a laborious process.

(3) It was not always possible to obtain the required radon content in the glass seed, and a considerable proportion of the radon was not of a usable strength.

(4) The needles made in this way always represented a compromise between filtration and external diameter.

(5) Only a restricted number of needle lengths could be made available.

For these reasons, the glass capillary method was replaced early in 1930 by the gold-tubing technique developed by Failla (6). In this technique, the purified radon is led into a capillary tube of pure gold with a very fine bore (0.16 mm.); pure gold tubing is used, because it can be readily subdivided with gas-tight seals by the use of a special form of pliers which produce an autogenous weld as they cut. The gold capillary had an external diameter of 0.82 mm., with an equivalent screenage of 0.3 mm. Pt. The subdivided sections could be inserted directly into the tissue as permanent implants. Although these were a great improvement over the glass-tube type of permanent implants (7, 8), clinical experience showed that, in the majority of cases, a filtration of more than 0.3 mm. Pt equivalent was desirable. Accordingly, in 1934, gold capillary of external diameter 1.25 mm., giving a screenage of 0.5 mm. Pt equivalent, was used for the construction of permanent implants. These contain up to 1.1 mc. per implant and are issued with lengths ranging from 3 to 5 mm. according to the strength of the radon-filled capillary available. Permanent implants are used in many sites where the use of temporarily inserted needles is contraindicated (9). Less than 4 per cent of the radon used in Australia in 1942, however, was in the form of implants, so that the popularity of radon is not dependent upon those cases in which it presents the only possible therapeutic method.

The 0.3 mm. Pt equivalent radon-filled capillary could also be placed within metal sheaths to form Muir tubes or short needles. Initially, sheaths of nickel from 5 to 10 mm. long were used; these were

constructed from nickel tubing, one end being first burnished over to hold the knot of a linen thread, while the other, after insertion of the capillary, was burnished over to hold it in place. Later, needles of varying length up to 8 cm. were issued, the sheath being burnished over to form a suitable point (8). The total screenage of the capillary and casing could be either 0.4 or 0.5 mm. Pt equivalent, the lesser filtration being chosen by those radiotherapists who preferred needles of smaller external diameter. In general, all needles were used with a strength of 2 mc./cm.; the 0.3-mm. gold permanent implants contained about 1.5 mc. in a length of from 6 to 8 mm., these values being selected as a result of clinical experience (10).

At the Third Australian Cancer Conference in 1932, the question of adequate screenage of radium containers received careful consideration, and a committee appointed to survey the position reported (11) that for the effective treatment of certain types of cancer, and especially for the treatment of lesions in certain sites, increased screenages were desirable. The committee was guided to a considerable extent by the experimental investigations of Wright, who implanted radon needles with filtrations of 0.5 and 0.8 mm. Pt equivalent, respectively, in corresponding situations on opposite sides of animals, the radon contents of the needles being adjusted to give equal emergent gamma ray intensities. Examination showed that with the needles of lower filtration, the immediate periaxial zones of destruction were much wider, while late necroses tended to occur in the sites treated (12). For gynaecological work, the committee recommended that 5-mg. tubes should have a filtration of 1.0 mm. Pt equivalent, and 10-mg. tubes and higher should have 2.0 mm. Pt equivalent, while for cases where needles were placed in close proximity to bone, cartilage, or important nerve trunks, or in the bowel, the filtration should be 0.8 mm. Pt equivalent. In accordance with these recommendations, a considerable proportion of the Commonwealth

radium was increased in screenage, and radon needles with a filtration of 0.8 mm. Pt equivalent were developed in the Commonwealth Laboratory and issued towards the end of 1932. To obtain the maximum screenage with a minimum thickness, a metal of high density must be used, and pure gold has been found the most suitable. The needle sheaths were constructed of tubing with a bore just large enough to take the radon-filled sections of capillary and with an external diameter of 1.93 mm. These needles could be obtained in lengths up to 10 cm., strengths of 1.5, 1.8, and 2.0 mc. being most frequently used because in this way established radium techniques could be duplicated.

As a result of the adoption by individual radiotherapists of techniques by which needles of a variety of strengths are used to obtain a practically uniform irradiation field and the desired dosage distribution, such as those developed by Paterson and Parker in Manchester (13), radon needles were issued with any strength required by the radiotherapist. By 1939, the Paterson and Parker technique had been introduced into all the principal Australian hospitals, and large-scale graphs, prepared by this Laboratory based on those developed in Manchester and modified where necessary, were in general use.

The availability of radon needles of any required strength is an important advantage in applying rationalised irradiation techniques. In these techniques, the radiotherapist determines the dimensions of tissue to be treated, the average dose required in roentgens, and the preferred time of treatment, and the required dosage in milligram-hours is read from the graphs. If radium is to be used, the available range of strengths and lengths of radium needles is then considered, and frequently the volume treated and the duration of treatment have to be adjusted to conform with the radium needles chosen. With radon needles, however, the required lengths and strengths are calculated to satisfy the chosen conditions. Radon needles are available in half-centimeter sizes from 1 to

5 cm., and in centimeter sizes from 5 to 10 cm., while strengths ranging from 0.2 to 1.0 mc./cm. in steps of 0.05 mc./cm., from 1 to 2.0 mc./cm. in steps of 0.1 mc./cm., and from 2 to 5 cm. in steps of 0.25 mc./cm. are available. Still other strengths can be obtained by special arrangement. Strengths greater than 1.5 mc./cm. are generally used in the construction of superficial applicators, while the very high strengths are used only for large treatment distances or in sites where the inability of the patient to tolerate the applicator reduces the duration of the treatment considerably below the customary seven days.

The extent to which the range of lengths and strengths of radon needles makes possible a ready arrangement of sources to provide homogeneous irradiation of irregular blocks of tissue can best be illustrated by the particular example given in Appendix I. It is evident that any hospital would require a very large reserve of radium needles of a wide variety of lengths and strengths to treat within the required dosage limits such a volume of tissue.

It is not, of course possible to fill the capillary with radon to exactly the required strength at the time of insertion in the patient. The needles are constructed by selecting a capillary with a strength slightly greater than that required for the needle (14); if the active length of the needle is a cm., and the required content is obtained in b cm. of capillary, then the needle is filled with $n + 1$ pieces of capillary, giving a total length of b cm., separated one from the other by n packing pieces of copper wire having a total length of $a - b$ cm. Provided that the lengths of packing are small compared with the active sections of capillary, it can be shown, both theoretically and experimentally, that the composite needle approximates closely a uniform linear source.

Where needles were to be used for constructing superficial applicators (used with a skin distance of 0.5 or 1.0 cm.) the capillary was sometimes placed, for reasons of

economy, in silver casing with the same dimensions as the gold casing, but giving a total filtration of 0.5 mm. Pt equivalent. Of recent years, however, gold casing of 0.8 mm. Pt equivalent has been used for both superficial and interstitial applicators.

For lesions of the eye, needles of up to 3 cm. in length are available with an external diameter of 1.74 mm. and an equivalent screenage of 0.7 mm. Pt. When the point is being burnished over, the knot of a second thread can be included in this end, giving a needle threaded at both ends to facilitate accurate positioning. These needles were designed for subconjunctival implantation, but may also be used in other sites where a needle of small diameter is required.

During 1942, approximately 70 per cent of the radon used in Australia was mounted in needle form, and it can be claimed that the demand for this type of container is due to the following advantages:

(1) Radon needles are constructed in the particular lengths and strengths necessary to deliver the required dosage for the particular lesion for which they are ordered.

(2) Radon can be enclosed in a much smaller volume than an equivalent gamma ray source of radium. Gold radon needles with a screenage of 0.8 mm. Pt equivalent have an external diameter of 1.93 mm. compared with 2.30 mm. for a platinum radium needle of the same screenage, thus facilitating their insertion into the tissues.

(3) Radon needles (containing gold capillary) can be bent as desired to suit the anatomical site.

(4) Radon needles can be obtained in much greater lengths than radium needles.

(5) The active length of a radon needle approaches the total length much more closely than in the case of a radium needle; for longer needles, the difference is 0.5 cm., for short needles 0.3 cm. This is of considerable advantage when "crossing ends" of an implantation.

(6) Experimental types of radon needles, or needles designed for special circumstances (*e.g.*, with inactive lengths

where desired), can readily be constructed to suit the particular needs of individual cases.

(7) Since the needle cases are fitted with threads before filling, the radiation exposure of the hospital staff is decreased.

For gynaecological work, the early applicators were chromium-plated brass tubes with an active length of 2 cm., a filtration of 1.0 mm. Pt equivalent, and an external diameter of 6.37 mm. These tubes contained one or more pieces of radon-filled capillary to give a linear strength as desired up to 20 mc./cm. Later, a special type of applicator for the treatment of carcinoma of the cervix uteri was developed by Cuscaden and Oddie (15), consisting of a square rigid pessary of vulcanite containing four tubes placed around the cervix (one of which is screened dorsally by 8 mm. of lead to protect the rectum) and an intra-uterine tube of the required length with the radon distributed in three sections to obtain the required shape of isodose curves. To obtain satisfactory screenage with a minimum diameter, these tubes are made of pure gold, giving a total screenage of 1.8 mm. Pt equivalent with an external diameter of 4.75 mm. Where the higher filtration is required, gold tubes can also be used as an alternative to the brass tubes mentioned above.

For the treatment of carcinoma of the corpus uteri, a special intra-uterine tube was designed (16) with radon distributed in sections to give isodose curves enveloping the fundus.

For the treatment of non-malignant conditions of the uterus, a special intra-uterine tube was constructed in 1939 to the design of Dr. W. P. Holman and Mr. M. W. Ingram, B.Sc., of the Launceston Hospital. This tube contains radon distributed in two sections, the strengths of the sections being arranged to deliver 3,000 r in five days to the whole of the mucosa.

When radon is used in gynaecological applicators, it is possible to provide sources of any required strength in any position

in the applicator. It is therefore possible to adjust the distributed strengths to furnish adequate dosage to a uterus of any given dimensions much more easily than with radium tubes of fixed content, in which the increments of content are relatively large.

During 1942, the radon issued in the form of uterine applicators represented approximately 18 per cent of that used for treatment in Australia.

Applicators of various types for the treatment of nasal lesions have been prepared, when required, to suit the particular problem involved. These applicators take the form of rigid or flexible metal tubes filled with pieces of capillary.

Following the arrival of the U. S. Army in Australia, Major J. E. Bordley, formerly of Johns Hopkins University, wished to use the method developed there of destroying lymphoid tissue in the eustachian tubes by the use of radon. For this purpose, a special form of applicator was constructed. A brass rod 2.82 mm. in diameter was drilled with a hole of diameter 0.82 mm. to a depth of 2 cm., and a piece of gold capillary inserted for 0.5 cm. and sealed with gold solder. The capillary served to connect the applicator to the radon purification apparatus and provided the seal after filling; the source was then screwed into a handle of the same diameter and of convenient length. Sources of 400 mc. with a filtration of 1 mm. of brass could easily be placed in applicators of these dimensions; in general, the content ranges from 250 to 400 mc., depending on the amount of radon available. Thirteen of these applicators have been supplied at monthly intervals.

Since all radon containers are prepared in the issuing laboratory for the individual case, provision is required for the accurate measurement of the radon content. This involves the comparison of the intensities of the gamma rays emitted by the radon source and a radium source of known content, due allowance being made for differences in screenage, size, and shape of the two sources. The Commonwealth

Laboratory possesses an international substandard radium source and the corrections necessary in the measurement of the various types of radium and radon containers, as well as various measuring equipments, have been investigated (17). Each radon centre possesses a set of substandard radium tubes calibrated in terms of the Australian standard, and these are used in the measurement of radon content.

When radon is first introduced into the capillary, no Radium B and Radium C are present, and there is no gamma ray activity. As these two products are successively formed and decay, the gamma ray intensity increases until a maximum is attained in approximately five hours, when equilibrium is reached; thereafter the decay characteristic of radon, with a half-value period of 3.825 days, is followed. In practice, the capillary is measured approximately one hour after filling, and the final content determined from a knowledge of the growth curve and the time elapsing between the filling of the capillary and the measurement. The radon content in mc./-cm. of lengths of capillary approximately 10 cm. long is calculated, and the capillary is subdivided in sections to give the content required in the different containers at the intended time of commencement of treatment. These sections are then inserted into the needle casing or other container, the whole operation frequently being completed before maximum intensity has been reached. The handling of the containers during the relatively inactive stage is an important factor in reducing the radiation exposure of members of the staff.

In general, it is necessary to fill different sections of the capillary at any one purification with a range of strengths determined by the containers on order. These sections are then subdivided into lengths of approximately 10 cm. The accuracy with which any needle can be filled with the required content at the first intent depends upon the uniformity of linear strength within the various sections. If a number of 10-cm. lengths are cut from a

section filled with a given pressure of radon, the strengths of the individual lengths usually lie within 5 per cent of the mean value, and when these 10-cm. lengths are further subdivided the variation is usually less than one-half this amount. A greater unevenness of distribution frequently results if the radon is not purified sufficiently before being led into the capillary. The subdivision of the measured capillary to provide pieces of the required content for constructing needles and tubes is carried out with pliers mounted on a fixed fulcrum, the length of the pieces cut being determined by a micrometer adjustment. These pliers have been designed to reduce the flattening of the capillary and the extent of the chisel ends to a minimum. Possibly because of this, there is no marked concentration of the radon along the capillary such as has been reported by some workers. Since, further, the pieces for a number of needles of the same strength are cut together and each needle is filled with pieces selected at random, the effect of small variations in the linear strength of the capillary tends to be eliminated.

The extent to which the active content of needles can be obtained with the desired value merely as the result of preliminary measurement of 10-cm. lengths and subdivision into the required portions can best be illustrated by the analysis of over a thousand needles of varying content from 0.5 to 10 mc. given in Table II.

TABLE II: COMPARATIVE ANALYSIS OF DEVIATIONS OF ACTUAL FROM NOMINAL CONTENTS FOR RADON AND RADIUM NEEDLES

Deviation from Nominal Content	Radon Needles, Per Cent	Radium Needles, Per Cent
Within 2.5 per cent	46	22
Within 5.0 per cent	78	47
Within 7.5 per cent	92	91
Within 10.0 per cent	97	97

The active contents of any needles outside any required limit can be readjusted. Very few needles as issued are outside 6 per cent of the stated value, while in general the total content of the applicators required for any one lesion is within 2 per cent of the stated value.

A more complete understanding of the real meaning of the accuracies of the contents of radon needles as stated above can be gained by a comparative analysis of approximately 400 radium needles varying in content from 0.5 to 10 mg. measured as delivered by a reputable manufacturer and set forth in Table II. It will be seen that the variation of the actual from the nominal values was more marked with the radium than with the radon needles. Further, since a marked preponderance of the radium needles showed a value higher, rather than lower than the nominal value the total content of any selection of these radium needles for a particular lesion would be somewhat outside the limits possible with the radon needles, where the needles were found to be more uniformly distributed about a mean value.

The success of any form of radon container depends upon the certainty with which gas-tight seals can be made during subdivision. This depends principally upon the design of the cutting pliers and the extent to which they are maintained in good order. In testing the performance of cutting pliers, it is convenient to solder a number (say ten) of pieces of gold capillary into the end of a metal cylinder attached to a compressed gas reservoir and fitted with a pressure gauge. In this way the efficiency of the pliers in making, say, 100 seals adequate to withstand, say, three atmospheres can be determined quickly. Pliers satisfying these conditions produce the much lower pressure radon-tight seals with certainty, provided the seals are made with a firm and continuous pressure.

Radiotherapists who use large numbers of radon needles annually very rarely have cause, from the observations of clinical results, to suspect radon leakages from needles. A needle which leaks before insertion in the patient will produce a lessened or negligible biological reaction, while leakage of radon into the tissues produces the violent necrosis associated with the action of alpha and beta rays. During the early years leakage from gold capil-

lary was occasionally detected, either in the radon laboratory or in the hospital, but this was found to be due either to minute air bubbles in the gold rod from which the capillary was drawn or to traces of grease introduced into the bore of the capillary during manufacture. Direct enquiry at the Royal Melbourne Hospital Radiotherapy Clinic (which has used an average of 11,000 mc. annually over the last eleven years) shows that the clinicians have absolute confidence that the radon sources as ordered will deliver the dosage calculated (18). Only on the rarest occasions is the expected degree of biological reaction not obtained, and it is considered that such effects are more often due to faults in planning or in implantation technique than to defects in the radon apparatus.

Doubts have been expressed at times as to the ability of the gold seals to tolerate the increased temperature of a steriliser. Experience here, however, has confirmed the statement (19) that sterilisation by boiling is a perfectly safe procedure. In fact, when for a particular investigation it was desired to extract the radon from a filled capillary, it was found impossible to cause the radon to leak out until a temperature of approximately 900° C. had been reached.

In filling the active sections into a needle, however, it is possible, by using excessive force, to damage the seal mechanically by ramming the sections together. With a little training, and specially designed filling devices (14), filling can be accomplished without risk of damage and subsequent leakage.

The Commonwealth Laboratory is responsible for the construction of the gold tubing and special types of applicator used by all centres. Approximately 100 ft. of 0.3-mm. capillary, 12 ft. of 0.5-mm. capillary, and 7 ft. of casing are required monthly. All used radon needles and tubes are returned to the centres after removal from the patient, stored until inactive, and then reopened. The casing is used again to make a smaller needle and

the capillary and scrap are purified to special specifications and reconstructed into tubing. Apart from the capital outlay for gold (on which there is no depreciation) the expense involved is that for reconstruction of the tubing and refining of the scrap, approximately £45 per month for all Australian requirements.

The development of radon containers of the types set out above has thus provided an alternative agent to radium in practically all cases. The Commonwealth radium is distributed only among those Australian hospitals which have on their staffs radiotherapists experienced in its use and which provide the necessary auxiliary clinical and clerical services. The majority of these hospitals are concentrated in the State capitals. Issues of radon are similarly restricted to hospitals which have radiotherapists experienced in its use, and in most cases radon is used in hospitals which have also a supply of radium. The choice of radon as a therapeutic agent is therefore made by the radiotherapist, taking into consideration the suitability of the available radium for the particular lesion. Radon is, however, frequently preferred when the patient can be treated as an out-patient, since the low intrinsic value of radon permits of this being done, whereas hospitalisation is essential when radium is used.

When radon is available after the requirements of hospitals have been satisfied, it may be issued to radiotherapists who are experienced in its use, for the treatment of private patients. Radon issued to public hospitals is made available free of charge; that issued to private radiotherapists is charged for on a sliding scale, which commences at a minimum of £1.1.0 for 15 mc. and rises in increments of 5 mc. to £3.1.0 for 50 mc., £4.15.0 for 100 mc., and £7.5.0 for 200 mc.

Since the various Australian radon centres have developed along lines suggested by local requirements, the general conditions of radon mounting and issue vary somewhat from centre to centre. A brief survey of the characteristic features

of each centre will indicate the various possibilities of radon services.

The Australian scheme for radiological-physical services provides for a central laboratory serving as the standardising and advising centre, together with local physical services situated in each State. The radon centres are associated with these local services, so that the preparation of radon is in the hands of physicists and technicians who specialise on a whole time basis in radiological physics, and who are in constant touch with the radiotherapy departments of the local hospitals. The physical problems arising in radon production and issue, therefore, are not treated in a limited sense, but as a portion of a general radiotherapeutic service. The close association of the physical service with the practising radiotherapist is essential in developing that spirit of co-operation without which little progress would have been possible.

THE COMMONWEALTH X-RAY AND RADIUM LABORATORY

The Commonwealth Laboratory, housed since 1938 at the University of Melbourne in a specially designed building erected with funds provided by the Anti-Cancer Council of Victoria, takes care of the radon requirements of Victoria, Tasmania, and southern New South Wales. The laboratory is equipped, staffed, and maintained by the Commonwealth Department of Health, the Anti-Cancer Council of Victoria making an annual grant in return for the radon and local physical services provided by the laboratory in that State.

The area served with radon from the Commonwealth Laboratory contains a population of 2,235,000. Other radiotherapeutic facilities distributed throughout the area include 2.4 gm. of radium mounted in the form of plates, needles, and tubes, and 10 deep-therapy and 2 contact-therapy x-ray units, together with more than 20 units used for superficial therapy.

Radon is prepared from 1,845 mg. of radium in solution, two identical purifica-

tion equipments being available. Purifications are carried out on the average daily from Monday to Friday, issues being made when required on these days and when necessary on Saturday. Since in all hospitals the honorary radiotherapist system is in force, radon is used in any particular hospital only on the radiotherapist's operating day (or days). These have been adjusted between the hospitals to equalise as far as possible the daily radon requirements. Issues to private practitioners are made on any day on which the radon is available.

During 1942, issues were made regularly to eight hospitals in Melbourne and ten in rural districts, as well as to eight private radiologists in Melbourne and six in the country. Total hospital issues amounted to 31,931 mc., while those to private radiologists totalled 7,820 mc., 1,108 patients being treated in all. The radon was distributed among the various types of containers as follows: implants, 2 per cent; needles, 75 per cent; tubes (uterine and nasal), 23 per cent. Of the radon issued in needle form for interstitial use, 13 per cent was at a strength of less than 0.75 mc./cm., 37 per cent was between 0.75 and 1.0 mc./cm., and 50 per cent between 1.1 and 1.5 mc./cm. The needles were distributed among the various lengths as follows: less than 4 cm., 58 per cent; between 4 and 7 cm., 32 per cent; over 7 cm., 10 per cent (20). All containers remain the property of the Laboratory and are charged for if not returned. Radon users exercise considerable care of these containers, as of the 6,436 issued last year, only 16 were not returned.

Issues to centres outside Melbourne last year amounted to 5,746 mc. Country centres using radon are situated 45, 100, 110, 145, 204, 260, 325, 380 and 580 miles, respectively, from Melbourne. The last-mentioned centre, a U. S. Army Base Hospital, received 1,023 mc. Radon is transported in specially designed lead boxes by air or fast passenger train, operations at the centre being arranged to take place soon after arrival.

For the period June 1940 to September 1942, the Sydney radon centre was out of commission due to the reconstruction of the local physical service and delays occurring in preparing new accommodation. During this time radon was made available from the Commonwealth Laboratory, issues being forwarded twice weekly, leaving Melbourne by train at 6 P.M. and arriving in Sydney, 575 miles distant, at 9 A.M. the following day. Issues made in this way during 1942 amounted to 4,462 mc. for use in Sydney by six hospitals and seven private radiologists. The total issues made to centres outside Melbourne, therefore, amounted to 10,208 mc., being 26 per cent of the total treatment issues.

The operation of a centralised radon service of this type requires very careful organisation. Orders for radon are required three days before issue; in the case of country orders, optional delivery days are often stated. A special telegraphic code has been developed for the use of country centres, whereby quite complicated orders for needles of varying lengths and strengths, together with full information regarding type of threads required, time of insertion, etc., are transmitted at small expense. In general, a country centre is just as favourably placed as one in Melbourne in obtaining prompt deliveries of orders given.

The figures given above refer always to the number of millicuries at the time of insertion. Because of the decay occurring between the time of preparation and insertion, however, an appreciably larger amount of radon is required to fill the applicators. There is also a wastage of radon when the orders received are less than the radon available on any one day, or when radon available on one day has to be used to fill a large order on the succeeding day. Naturally, the weekly requirements from the hospitals vary considerably. During 1942, the average weekly issue for all purposes was 910 mc.; the actual issue was under 600 mc. for five weeks, between 600 and 800 for twelve weeks, between 800 and 1,000 for sixteen weeks, between 1,000

and 1,200 for fourteen weeks, between 1,200 and 1,400 for four weeks, and one week it exceeded 1,500 mc. The satisfaction of such fluctuating demands requires the most careful planning of the available supply. When it is known that a portion of the radon purified on one day will not be required until two or three days later, then it is filled into a section of the capillary at such a strength that after decay it will still be in the usable range. A supply of filled capillary of various strengths is practically always on hand, and from this urgent orders can usually be filled at a few hours' notice.

SYDNEY RADON CENTRE

The Sydney Centre was originally established in 1929 in association with the Physics Department of the University of Sydney and was operated by the Cancer Research Committee of the University. In 1940, the local physical services were reconstituted under the Hospitals Commission of New South Wales. The service is now located at Royal Prince Alfred Hospital with Mr. B. W. Scott, B.Sc., in charge. The area served by this centre has a population of 2,775,000. Other radiotherapeutic facilities available include 3.9 gm. of radium in plates, needles, and tubes, 8 deep-therapy x-ray units and one contact-therapy x-ray unit, together with a number of units for superficial therapy. Radon from 500 mg. of radium in solution is issued to eight hospitals and five private radiotherapists in Sydney. In general, radon is purified twice weekly and arrangements have been made as far as possible for the application of the radon to patients on two days weekly. During the year 1942, 6,552 mc. were used by hospitals, and 1,861 mc. by private radiotherapists.

Considerably greater use is made of permanent implants in Sydney than in other centres, so that an appreciable portion of the purified radon is filled into 0.5 mm. Pt equivalent gold capillary. From this the required implants are taken, and the remainder is then used without ad-

ditional mounting for constructing superficial applicators. For the needles and tubes required, radon is filled into 0.3 mm. Pt equivalent gold capillary. During 1942, 32 per cent of the radon issued was contained in 2,509 sections of 0.5 mm. capillary (used in approximately equal proportions for implants and superficial applicators), 60 per cent was in the form of gold needles, and 8 per cent in the form of tubes. In all, 609 patients were treated with radon from the Sydney Centre during the year.

ADELAIDE RADON CENTRE

The Adelaide Centre is operated by the Adelaide University Cancer Campaign Committee, with Mr. B. W. Worthley, B.A., B.Sc., in charge. The area served has a population of 600,000. Other radiotherapeutic facilities include 0.7 gm. of radium mounted in plates, needles and tubes, 4 deep-therapy x-ray units, and one contact therapy x-ray unit. Radon from 445 mg. of radium in solution is issued to one hospital and one private practitioner in Adelaide, purifications being made in general twice weekly. During 1942, 3,987 mc. were issued to the hospital, and 147 mc. for use in private practice. Less than 1 per cent of the radon used was in the form of permanent implants, and these were of 0.3 mm. Pt equivalent. All radon, therefore, is filled into 0.3 mm. capillary; 99 per cent of the radon issued was in the form of needles, 53 per cent being for interstitial use and 46 per cent being used in the construction of superficial applicators. A total of 243 patients were treated with radon during the year.

PERTH RADON CENTRE

The Perth Centre is operated by Professor A. D. Ross, and the staff of the Physics Department of the University under an arrangement with the Perth Hospital Board. The area has a population of 470,000. Other radiotherapeutic facilities available include 0.7 gm. of radium in plates, needles, and tubes, and 5 deep-therapy x-ray units, as well as some

units used for superficial therapy. The use of radon in Perth is somewhat limited, only 292 mc. being issued to the hospital and 572 mc. to private radiotherapists during 1942 from the 375 mg. of radium in solution. All radon was mounted in needle form. A total of 43 patients were treated with radon during the year.

BRISBANE RADON CENTRE

The Brisbane Centre serves a population of 1,020,000. Other radiotherapeutic facilities include 1.7 gm. of radium in the form of plates, needles, and tubes, 5 deep-therapy, 2 contact-therapy, and a number of superficial therapy x-ray equipments.

The centre is operated by the Queensland Cancer Trust, the Brisbane Hospital Board, and the University in conjunction, Mr. D. F. Robertson, B.Sc., being in charge (during the wartime absence of Dr. H. C. Webster) under the general direction of Professor Parnell. Radon from 469 mg. of radium in solution is issued to two hospitals and private practitioners in Brisbane. During 1942, 4,142 mc. were used by hospitals and 217 mc. by private radiotherapists. With the exception of 2 per cent issued in needle form, all the radon was filled into 0.5 mm. capillary, 11 per cent being used for permanent implants and the remainder for the construction of superficial applicators. Superficial applicators are used to a considerable extent in gamma ray therapy in Brisbane, and the use of the radon-filled capillary for these has been of considerable advantage both to the issuing centre and the radiotherapists, particularly as the physicist is available in the hospital to plan the required distribution as the applicator is being constructed. A total of 177 patients were treated with radon in Brisbane last year.

For eight months during 1942, issues of radon filled into 0.5 mm. capillary required in Sydney were supplied from Brisbane, 627 miles distant. A total of 1,336 mc. was issued, transportation being arranged by air freight or by train when the air service was dislocated.

ADVANTAGES OF CENTRALISED RADON SERVICES

It will be seen that a very extensive use is made in Australia of radon produced in centralised laboratories. Experience has shown that radon can be used as an alternative to radium and in some cases has very definite advantages, which have been enumerated above. A centralised radon service serving a number of hospitals has an additional advantage in that the radon available on any one day can be applied at those hospitals where gamma ray sources are needed, mounted with exactly the lengths and strengths required. Including the supplies forwarded to Sydney, the Commonwealth Laboratory in 1942 issued a total of 44,213 mc. to 24 hospitals and 21 private practitioners distributed in an area 800 miles long. In addition, a further 3,315 mc. were used for a variety of investigations. These figures correspond to a use for treatment of 23.9 mc./year/mg. of radium in solution and 25.8 mc./year/mg. for all purposes. As radon is usually applied for a seven-day treatment period, the used gamma ray activity of the total radon issued amounts to 2,460 mg. hr./year/mg. in solution, so that the total radium in solution was used continuously for fourteen and a half weeks in the year. Because of the extension of the use of radon in Australia, it is not possible to determine locally what proportion of the radium holding of any hospital is used each week. Had the total quantity of radium in solution (1,845 mg.) been mounted in a full range of radium needles and tubes of varying lengths and strengths and distributed among even the 24 hospitals participating, it would have been necessary for each radium container to be used for a total of fourteen and a half weeks in the year to supply an equivalent gamma ray activity. With the distributed radium only a small proportion of the available radium containers in any one hospital would be suitable either in length or strength for use on a particular lesion offering for treatment (*e.g.*, the case referred to on p. 168); it would obviously be un-

economical to subdivide 1,845 mg. among 24 hospitals, but even if 4 hospitals were chosen it would not be expected that the exact specifications of radium needles and tubes would be available when required, to permit an average use of each for fourteen and a half weeks in the year. The restriction of gamma ray sources to 4 hospitals in this area, however, would require considerably more traveling of patients to these centres to obtain treatment than is necessary at present. A centralised radon service makes it possible, therefore, to supply gamma ray sources just where they are required and to cover economically the needs of an area.

One particular advantage of centralised radon services was evidenced when, owing to the international situation, wartime control of radium became necessary. In January 1942, the radium holdings of all hospitals in Australia were reduced to a minimum and the use of radium was limited to those types of container which, on notice of an air raid, could be removed from the patient in a few moments and placed within steel bomb-proof containers. This serious limitation of the use of radium has not resulted in any serious curtailment of radiotherapeutic facilities, since the use of radon was not affected, as this does not introduce the health hazards and economic considerations of dispersed radium. In this connection it is of interest to note that special arrangements were made to operate the radon services, if necessary, from bomb-proof sites, and that two of the services have been so operated since that date.

Experience has shown that the customarily enumerated disadvantages of radon are more academic than real. Although the radiation from a needle falls to half its initial intensity in 3.825 days (*i.e.*, it has fallen to 28 per cent in seven days), clinical experience has not shown any differences between reactions occurring with a constant radium source and a varying radon source. Indeed, if the cumulative tissue dose is considered, it can be shown that there is very little difference between the

values obtained over a seven-day period using radium and radon (21). When treatments longer than seven to ten days are used (which occurs in general only with superficial applicators), a new set of radon needles can be applied.

Dosage calculations require more care with a varying source than with a constant source. Many of the dosage calculations, however, are carried out for the radiotherapists by physicists attached to the radon centres or to hospitals, and it has been found that with study radiotherapists can understand and use with ease tables of radon exposure factors (14). In certain cases (*e.g.*, treatment with intra-oesophageal applicators) where the radon source is applied intermittently according to the tolerance of the patient, a nomograph (22) can be used by the radiotherapist to determine the actual dosage in roentgens received during each application, and by summation the total desired dose can be delivered.

A specially equipped radon laboratory with a carefully trained staff is also required in each centre. In Australia, it has been the custom to improve protection arrangements and utilize a permanent staff rather than use temporary employees in radon production. The physicists engaged in radon production are trained in all branches of radiological physics; consequently the radon centre and the local physical service for calibrating x-ray equipment and determining x-ray dosages are operated together. The same team of physicists and mechanics, therefore, associates with both x-ray and gamma ray therapists, with considerable mutual advantage.

In handling large quantities of radon, very complete protective measures must be adopted to reduce the radiation exposure of the personnel to safe limits. This can be achieved by close attention to the following essentials.

(1) Storage of all radon capillary not actually being handled in adequately protected lead drawers.

(2) Rapid manipulation of radon in all

procedures where full lead protection is not possible. (For example, in measurement, the observer is at least 6 feet from the radon source which is being measured at appreciably less than its final strength.)

(3) Performance of all cutting of capillary and filling of needles, with the worker protected by from 4 to 6 inches of lead (14).

Regular surveys of the background radiation in various sections of the radon laboratory by an ionisation method (23) serve to indicate the areas of higher exposure and to direct attention to the necessity for additional protection. Dental films worn by the members of the staff over a working period can be developed and photometered to determine the actual exposure (24), and so direct attention to failure to utilize protective facilities provided. Finally, periodic blood examinations are required of all personnel.

Radon laboratories require thorough exhaust ventilation, while all manipulations of radon-filled capillary (such as cutting and filling into needles) should be carried out under evacuated hoods. Some form of ionisation measuring instrument should be set up permanently to indicate excessive ionisation; a projection electroscope with a very small natural leak will quickly show the presence of quite small radon concentrations. The fact that there has been no evidence of permanent change in the blood picture of radon workers in Australia indicates that satisfactory precautions against radiation can be taken. Where temporary changes in the blood picture have occurred, they have usually resulted from working in a radon-charged atmosphere arising during an accident, or when the cleaning of a radium solution has become necessary.

SUMMARY

Although on physical grounds radon can be used as an alternative to radium in treatment, in general a decrease in the use of radon has been observed in many countries. The use of radon has increased

steadily in Australia, however, and it is believed that this is due to the manner in which it is mounted for use.

All radon is filled into gold tubing. By the use of external sheaths, needles and tubes of a wide range of lengths and strengths can be constructed. Needles have proved to be of definite advantage in using rationalised systems of dosage distribution such as that of Paterson and Parker. The tubes permit the use of rationalised systems of uterine applicators with content selected to suit the dimensions of the uterus to be treated.

Altogether 57,500 mc. were issued for treatment purposes during 1942 from five radon-producing centres with a total of 3.66 gm. of radium in solution. Of this, less than 4 per cent was in the form of implants. Approximately 70 per cent was in the form of needles and 18 per cent in the form of tubes; the remainder consisted of radon-filled capillary used for constructing superficial applicators.

Radon issues are restricted to hospitals possessing radiotherapists experienced in its use. In the smaller capital cities the radon is issued to one or two hospitals and private practitioners, but the Melbourne and Sydney centres serve a number of hospitals, many of which are in remote rural districts. Such centralised radon services have been found to possess a number of important advantages, which are discussed in detail.

Acknowledgments: The developments in radon services described above have resulted from the associated activity of a number of workers, the publications of some of whom are referred to in the bibliography. The successive steps in the construction of radon needles and tubes were due principally to Mr. A. H. Turner, M.Sc., who was in charge of the Radium Laboratory from its establishment in 1929 until early in 1935. The development of the various types of needles was carried out in close association with Dr. L. J. Clendinnen, formerly Honorary Radiotherapist, and now Honorary Consulting Radiotherapist, to the Royal Melbourne Hospital, and with Dr. R. Kaye Scott, the present Honorary Radiotherapist to that Hospital, and of tubes with Dr. W. G. Cuscaden, Honorary Surgeon to the Women's Hospital, Melbourne. The sympathetic attitude of the Director-General of

Health (Dr. J. H. L. Cumpston, C.M.G.) and the Senior Medical Officer of the Commonwealth Department of Health (Dr. M. J. Holmes) at all times has been a constant encouragement to those directing the developments in radon services.

It is a pleasure to acknowledge the assistance of Dr. R. Kaye Scott, who read through the draft of this report, making several valuable suggestions, and provided the typical treatment data set out in the Appendix.

APPENDIX

The following example, supplied by Dr. R. Kaye Scott and Miss Wellington, B.Sc., of the Radiotherapy Clinic of the Royal Melbourne Hospital, of the irradiation of a breast with radon needles illustrates the usefulness of needles covering a wide range of lengths and strengths particularly in treating large lesions. The routine treatment of inoperable carcinoma of the breast in that hospital consists of initial x-ray therapy to reduce the primary lesion and extensions. In suitable cases, radon needles are then implanted in the breast and lymph node areas of the axilla some six to eight weeks later.

In the case presented, one large plane of needles was selected to deliver a dose of 6,000 r in five and three-quarter days at a distance of 0.5 cm. in a block of tissue of area 230 sq. cm. on the anterior chest wall in the plane of the deep fascia.

A second rectangular plane of needles 8 cm. by 6 cm. placed in the subcutaneous tissues of the breast and at a distance of 2 cm. from the first plane was selected to augment the dosage in the tumour-bearing tissues to a maximum value of 8,000 r. A plane of needles 10 cm. by 7 cm. placed parallel to the medial axillary wall was required to deliver to the tissues bearing the axillary nodes a dose of 7,000 r at a distance of 0.5 cm. in five and three-quarter days.

With the aid of the modified Paterson and Parker graphs and with due allowance for the effect of cross-radiation between adjacent needles in the breast and in the axillary implants, the following needles were required.

Breast

Large Plane: Area 230 sq. cm., 6,000 r at a distance of 0.5 cm.

Two 10-cm., two 8-cm., two 6-cm. needles at 0.9 mc./cm.

Eleven 10-cm., one 9-cm., two 8-cm., two 6-cm. needles at 0.6 mc./cm.

Total: 22 needles, 131.4 mc.

Small Plane: Area 48 sq. cm., 4,300 r at a distance of 0.5 cm.

Two 8-cm., two 6-cm. needles at 0.8 mc./cm.

Five 6-cm. needles at 0.5 mc./cm.

Total: 9 needles, 37.4 mc.

Separation of planes, 2 cm.: maximum dose 8,000 r, minimum dose 6,500 r.

Axilla

Area 70 sq. cm., 7,000 r at a distance of 0.5 cm.

Two 10-cm., one 3-cm. needles at 1.5 mc./cm.

Four 10-cm. needles at 1.0 mc./cm.

Total: 7 needles, 74.5 mc.

The dosages at 0.5-cm. intervals in passing from the large plane to the small plane were calculated to be 7,600, 8,000, 6,500, 7,200, and 6,800 r, respectively.

It will be seen that a total of 38 needles containing 243 millicuries was used, the needles comprising five different lengths and six different strengths.

The areas given above are those over which it was intended to implant the needles. After implantation, the areas were re-measured and radiographed and the actual area over which the sources were distributed was determined. When the actual area differs appreciably from the intended area, the irradiation result is recalculated and the duration of treatment altered to give the intended dosage. While area implantations are usually fairly accurate, it is not always possible to predetermine with accuracy the separation between superficial and deep planes. The treatment time must therefore be chosen so that corrections for interplanar distances greater or smaller than was intended may easily be applied. Because of the decay occurring in the radon sources, the time of five and three-quarters days chosen in this case permits the necessary correction to be made without increasing the treatment time unduly. Because of the limited number of hospital beds available, and because of the fact that the honorary radiotherapist operates on in-patient cases only once a week, an extension of the treatment times beyond one week is liable to introduce serious administrative difficulties.

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The Evolution of an Improved Transvaginal Speculum¹

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ANYONE WHO TRIES to add anything to the solution of the many problems met in the direct application of x-rays to cancer of the uterine cervix (1) must first acknowledge his indebtedness to E. A. Merritt. In 1920 (2) he treated cervical cancer, with rather spectacular results, using unfiltered x-rays through a glass speculum. The technical difficulties were tremendous. Because of the dangers of electrical shock and of accidental overexposure of the vulva, the tedium and discomfort of the treatments, and the impossibility of maintaining the lesion, the speculum, and the tube in fixed relationship, he had to abandon his efforts until high-powered, shock-proof apparatus became available. He then (3) began to apply x-rays to the cervix, and the tissues around it, through a speculum of the Ferguson type made of material transparent to the rays. He introduces the specula with the aid of obturators, and protects the vulva by a ring of opaque metal. The expanding beam of x-rays strikes the inner portion of the vagina and exposes a field surrounding the cervix which is much larger than can possibly be irradiated through opaque cylindrical specula. The dose to the vaginal wall increases as one nears the tube, according to the inverse-square law, but on the other hand, because of back-scatter, the intensity at the edge of a small field is about 30 per cent less than it is at the center. It is obvious, therefore, that the vaginal walls can be exposed for a distance from the cervix equivalent to one-fifth of the total anode-surface distance, without increasing the effective dose to the vaginal wall.

My own approach to the problem (4, 5) has been along different lines because of my obsession with the belief that a short

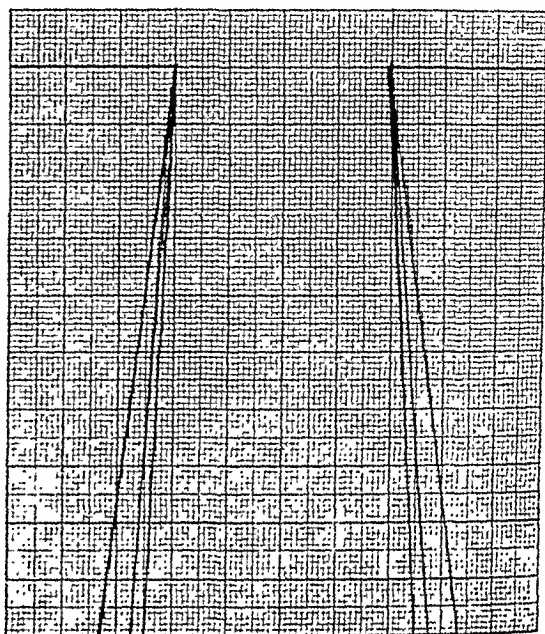


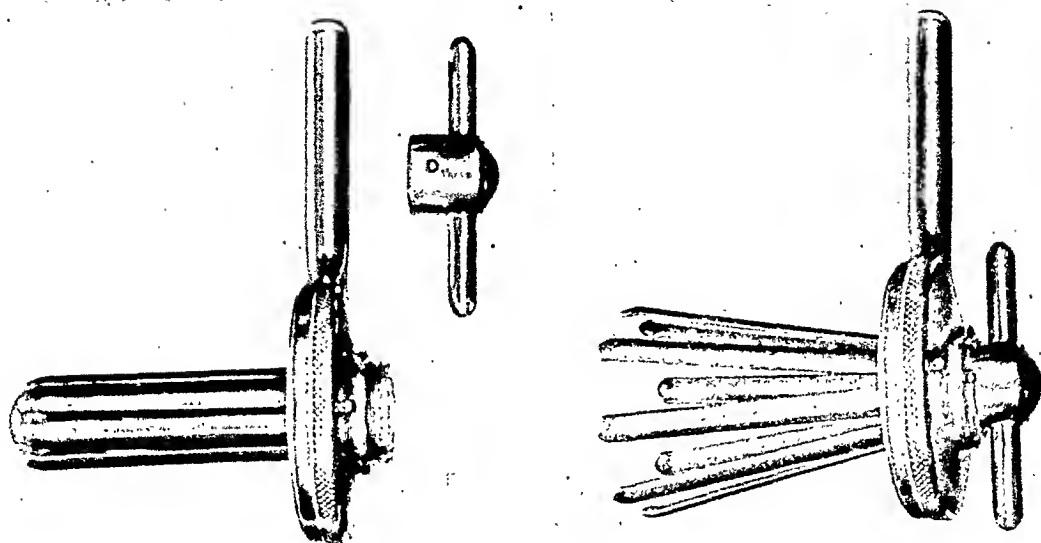
Fig. 1. Showing the rapid expansion of the beam with a short anode-surface distance. Through an aperture 4 cm. in diameter 10 cm. from the surface, the diameter of the field is 5 cm. when the anode-surface distance is 50 cm.; 5.5 cm. when the anode-surface distance is 35 cm.; and 6.6 cm. when the anode-surface distance is 25 cm.

(25 to 30 cm.) anode-surface distance should be used. There are three reasons for this belief:

1. As shown in Figure 1, the beam expands much more rapidly.
2. The time of the treatments, which at best are uncomfortable, is considerably shortened.
3. There is less danger of overexposing the rectum.

In order to use a short anode-surface distance, it is necessary to find some method of retracting a considerable portion of the vaginal wall. This I tried to do in 1937 with the eight-bladed expanding speculum shown in Figures 2 and 3. The blades of this instrument were 9 cm. long and the diameter of the opening at the introitus was 26 mm. The cone of rays exposed a field 4.5 cm. in diameter. Using

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.



Figs. 2 and 3. Speculum (first model) with blades closed and obturator inserted and with blades expanded.

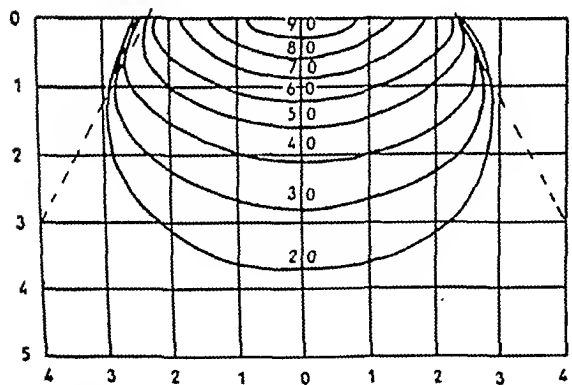
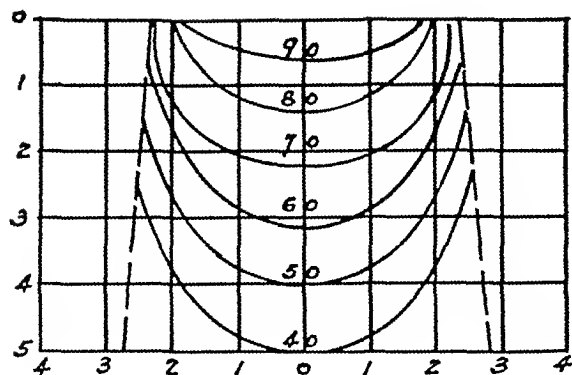
200 kv. and an effective filter of 0.75 mm. copper, and an anode-surface distance of 28 cm., an excellent distribution was obtained. It is shown graphically in Figure 4. It is interesting to compare this with the distribution obtained with the Chaoul technic and with radium. Mayneord (6), discussing rays from the Chaoul tube, says: "We may imitate fairly exactly the radium depth doses." This opinion seems to be supported by Arneson's exact study (7) of the distribution of the radiation from radium in colpostats in the lateral vaginal fornices, in combination with an intra-uterine tandem. Assuming that Figure 5 represents the approximate distribution of radiation with good Chaoul technic, and also with good radium technic, a comparison with Figure 4 shows that about 28 per cent of the surface dose in one case, and 63 per cent in the other, reaches a depth of 3 cm. Incidentally, I have recently made a study of the distribution of x-rays produced at lower voltages. With 135 kv. and a filter of 0.25 mm. copper, the depth dose percentage at 3 cm. is still much higher than it is with the best radium technic.

Because the greatest expansion of the blades of the first model was at their inner ends, where the patients were least able to endure the discomfort of dilatation, it was

found advisable to curve them and to substitute duralumin for steel. This instrument (Fig. 6) caused less discomfort but did not give such good visibility. It also considerably reduced the intensity of the dose at the edge of the field.

About two years ago I made an expanding blade instrument (Fig. 7) which, when closed, was approximately the shape of the Ferguson speculum. It consisted of eight blades with their inner ends joined together by a coil of duralumin wire, the blades being hinged at the junction of the aluminum and steel portions. When the instrument was covered with thin rubber tubing (cigarette drain), it was easily introduced and visibility was very good. When the blades were opened, the x-rays passed through their aluminum portion and exposed 3 to 4 cm. of the vaginal mucosa.

In the spring of 1942 several radiologists and physicists who had been using some modification of the transvaginal method met informally in Atlantic City. After J. C. Bouslog had emphasized the importance of adequate dosage to the lateral vaginal fornices, someone (probably A. N. Arneson) said that, since we want to expose as large a field as possible, and since it is more important to expose the lateral



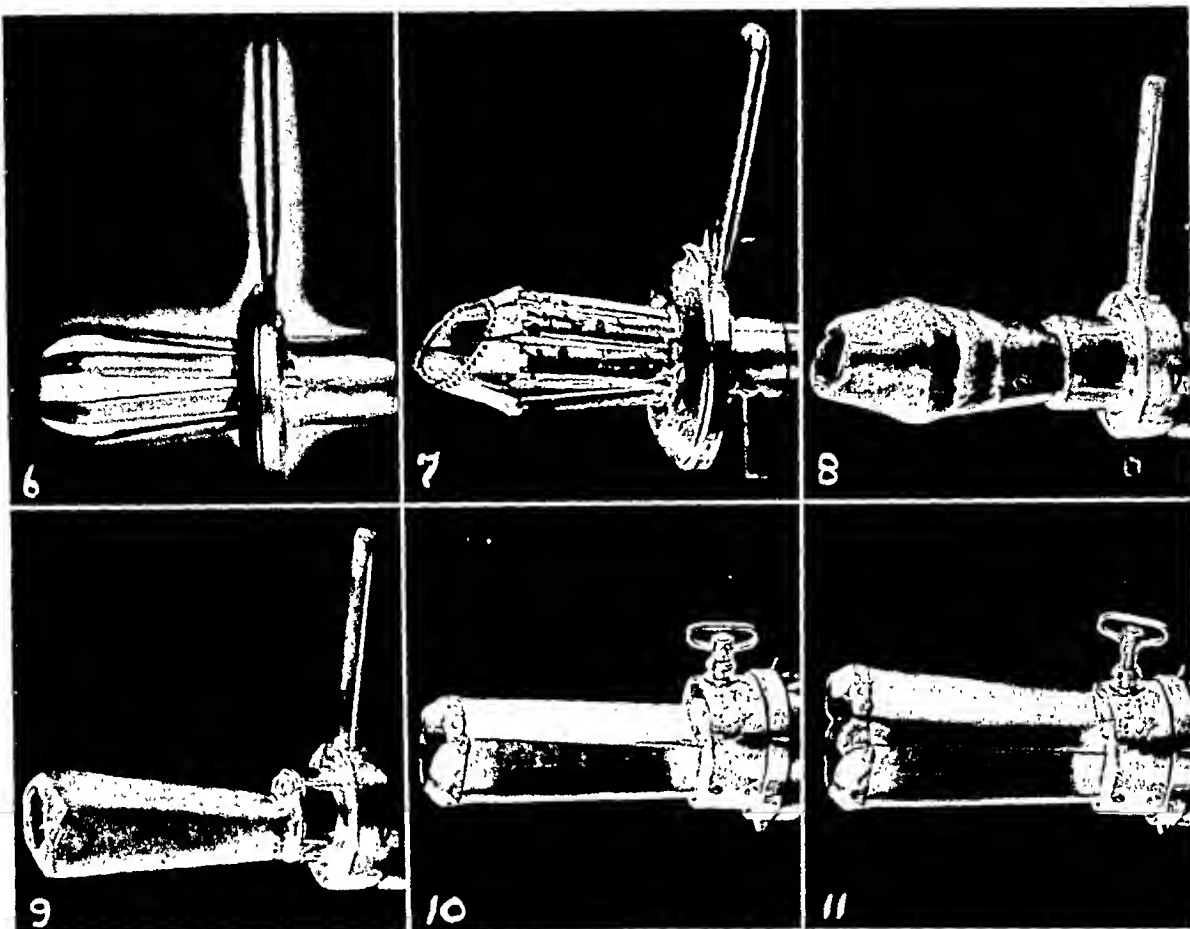
Figs. 4 and 5. Figure 4 (above) shows the distribution of radiation with transvaginal technic (first model, 4.5 cm. field). Figure 5 (below) shows, for comparison, the distribution with Chaoul's technic and with good radium technic (Mayneord).

vaginal fornices than the bladder and rectum, and since the size of the field is limited by the size of the introitus, it would be better to use an oval field than a circular one. I find it impossible to explain why this perfectly obvious fact was never recognized by any of us before. I spent most of the following summer making an expanding blade speculum, with the blades arranged in an ellipse instead of a circle. Since the lateral blades have to expand further than the anterior and posterior ones to keep the vaginal walls out of

the axis of the flattened cone, it is a difficult mechanical problem and the resulting instrument was so cumbersome and so difficult to keep in order and adjustment that it was impracticable.

The next step was to develop the speculum shown in Figure 8. The part which is inserted into the vagina consists of two portions. The outer portion is made of iron and is in the shape of a flattened cone. The inner portion, which is approximately the same shape, is made of celluloid. This speculum gives adequate protection and is not uncomfortable. It is so cheaply and easily constructed that one can have it in many sizes. Its great disadvantage is that the dose at the edges of the field is very much lessened, because the rays must pass through the tissues surrounding the celluloid flattened cone. Studies of distribution show that the intensity at the edge of the field was reduced to about 30 per cent of the center.

In order to increase the dose to the lateral fornices the instrument shown in Figure 9 was devised. It exposes a half-oval field and is a compromise with the Wasson (8) multiple field technic. After the speculum has been introduced into the vagina and attached to the tube head, it is shifted toward its rounded side so that its opposite straight side is in the mid-line. The exposure is then made, the speculum is turned over without removing it from the vagina, and is shifted in the opposite direction for the second exposure. The instrument can be easily and cheaply constructed, gives adequate protection and good visibility, and is not too uncomfortable. The greatest circumference of the most frequently used medium-sized speculum is 15.5 cm., and the dimensions of the combined two half-oval fields exposed through it are 5.5×8 cm. Diminution of intensity at the edge of the field because the rays had to penetrate several centimeters of tissue before reaching the lateral fornices, a disadvantage common to all the previous models except the first one, was overcome by making the inner end of the speculum nearly square. The only



Figs. 6-11. Evolution of the improved speculum. Fig. 6. Speculum with curved duralumin blades. Fig. 7. Cylindrical speculum with hinged steel and aluminum blades. Fig. 8. Flattened-cone iron and celluloid speculum. Fig. 9. Half-oval iron and celluloid speculum. Figs. 10 and 11. Two-bladed expanding oval iron and aluminum speculum, closed (Fig. 10) and open (Fig. 11).

objection to this speculum is that it is difficult to be certain that the straight edges of the two half-oval fields coincide exactly, or that they do not overlap, at most, more than a centimeter.

Soon after starting to use the half-oval speculum, it became apparent that it is feasible and practicable to return to a simplification of the expanding blade principle, and I constructed the two-bladed oval speculum shown closed in Figure 10 and expanded in Figure 11. With expansion, the blades assume the shape of an oblong truncated pyramid with rounded corners. Although I use a 25 cm. anode-surface distance, the sides of the speculum coincide with a pyramid whose height is 35 cm. The reason for this apparently needless widening of the outer portion of

the speculum is that in modern therapy tubes the focal spot is not a point. Its area is considerable. The two-bladed oval expanding speculum more nearly meets the requirements for a satisfactory instrument than any of the earlier models. These requirements are as follows:

1. Even exposure of a sufficiently large oval or oblong field.
2. Good visibility.
3. Comfort.
4. A short (not more than 30 cm.) anode-surface distance.
5. Rigidity.
6. Cheapness and simplicity.
7. Protection of the vulva.

Two sizes are enough for the great majority of patients. The larger, whose

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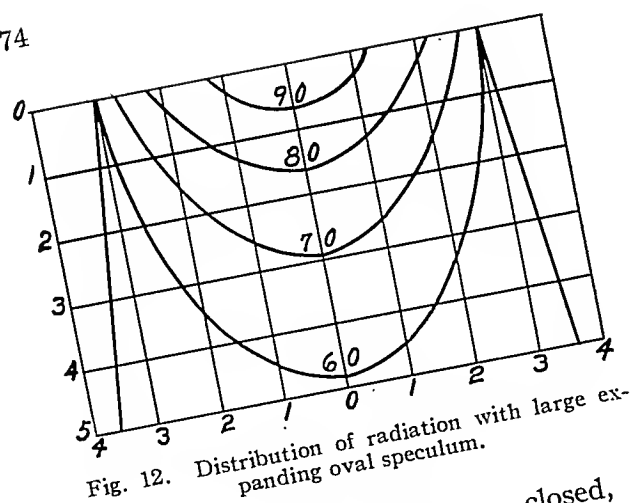


Fig. 12. Distribution of radiation with large expanding oval speculum.

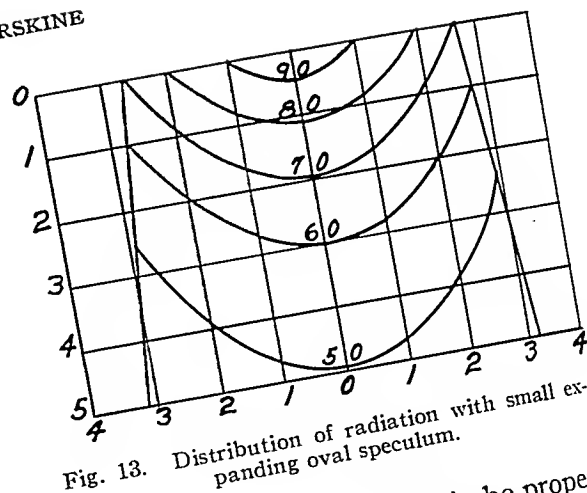


Fig. 13. Distribution of radiation with small expanding oval speculum.

greatest circumference, when closed, is 14.5 cm., exposes a field 5×6.5 cm. The smaller, whose circumference is 13 cm., exposes a field 3.75×5.25 cm. If neither can be inserted and expanded, I use one of the half-oval specula. The following physical factors are employed: kv. 200; ma. 20; A. S. D. 25 cm.; effective filter, Cu 0.75 mm.; hardness, expressed as half-value layer in copper, 0.9 mm. The distribution of the rays through the large and small two-bladed expanding oval specula is shown in Figures 12 and 13, respectively.

If these graphs are accurate, we should be able to deliver an aggregate dose of 6,000 r to the tissues at a depth of 3 cm. without producing necrosis of that portion of the cervix nearest the tube. With such dosage and distribution, we should be able to cure nearly all cervical cancer in Groups I and II. My own experience, while limited, seems to justify the foregoing theoretical conclusions. I can treat the lesions which can be completely included in the field with nearly as much confidence as I treat localized cancer of the lip. Of 22 patients treated before Jan. 13, 1939, 11 lived five years or longer. This 50 per cent five-year survival rate, while not spectacular, is satisfactory, since more than half of the patients were originally classified in Groups III and IV, and also because not all the deaths were from cancer.

A question which must have occurred to many is, can Group I and, perhaps,

Group II cancers of the cervix be properly treated by the transvaginal method only, and the long, trying, expensive series of cross-fire treatments be omitted? Much might be said on either side of this question. If early cervical cancer can be properly treated with radium only, if ulcerating cancer of the lip can be properly treated by excision or irradiation without removal or irradiation of the cervical nodes, and if early breast cancer can be properly treated by operation without postoperative x-ray treatment, the answer to it should be "Yes."

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A Barium-Gelatine Mixture for the X-Ray Examination of the Digestive Tract¹

LIEUT. MARTIN S. ABEL, M.C., A.U.S.

THE PRESENT experimental study of the use of liquid barium-gelatine mixtures for the routine roentgen-ray examination of the digestive tract was undertaken in the hope that it might prove possible to eliminate, so far as possible with

sary to use a fairly concentrated suspension of barium in an effort to outline a hollow viscus completely. When this effort is successful, the organ is rendered completely opaque, so that only defects fortuitously seen in profile will be diagnosed.

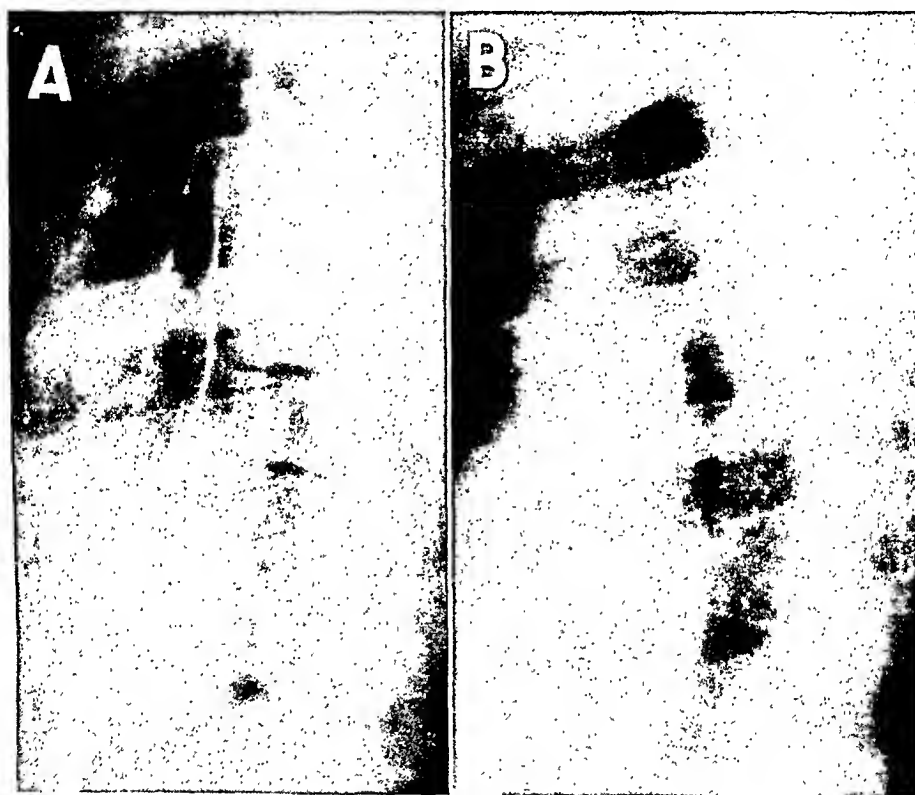


Fig. 1. Normal esophagram. A. Immediately after ingestion of barium-gelatine mixture. B. About 1 minute later.

station hospital facilities, the undesirable properties of the available barium and water mixtures and perhaps even improve on barium-acacia preparations, which were not available.

The first and foremost undesirable property of simple barium-water mixtures is the tendency of the barium to settle out of suspension. Because of this, it is neces-

Another highly undesirable property of the barium-water mixtures is their lack of adhesiveness to the walls of the gut. A simple suspension will pass along without leaving a discernible trace a moment after the bolus has passed. A medium that would stick to and outline the mucosal folds of the digestive tract for an appreciable interval would be most desirable. It is agreed that much information can be obtained from a mucosal study of the esophagus (4), stomach (5), or colon (3).

¹ From the X-Ray Department, Station Hospital, Mississippi Ordnance Plant, Jackson, Miss. Accepted for publication in December 1943.

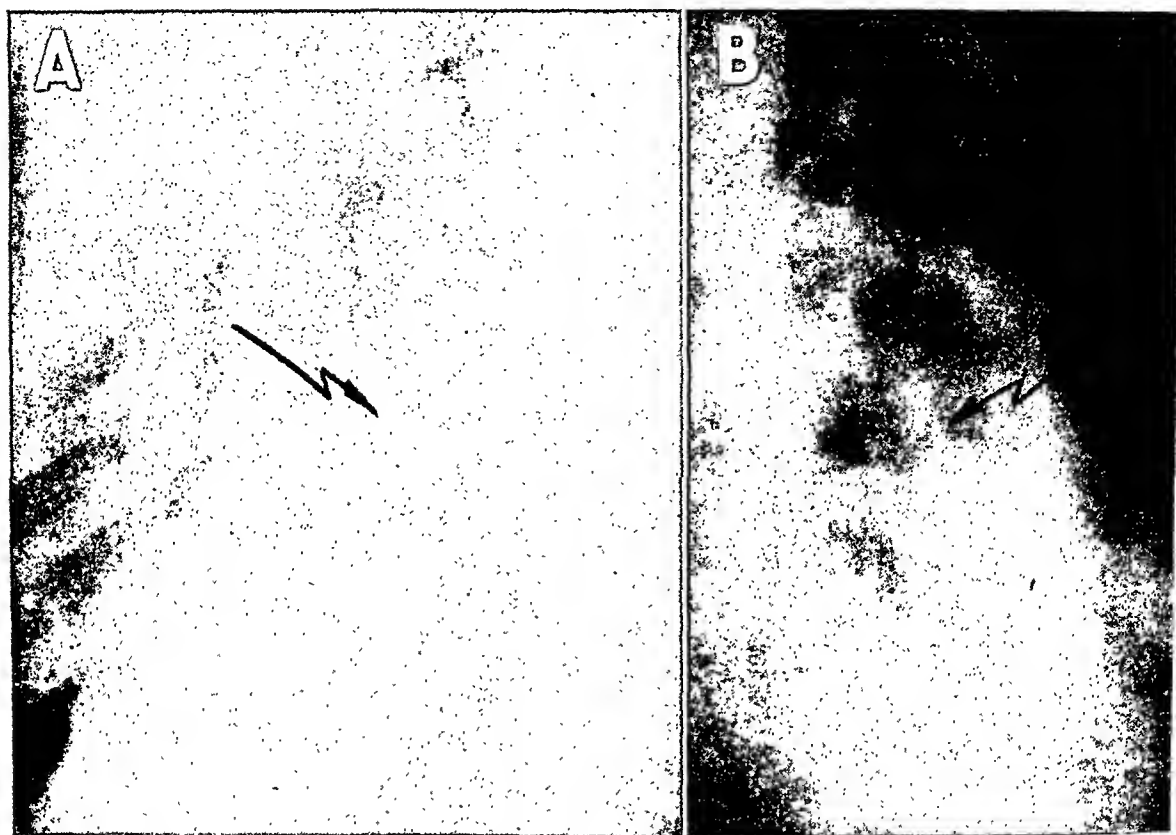


Fig. 2. A. Esophagram taken immediately after ingestion of radiopaque mixture, showing smooth pressure defect caused by pressure of mediastinal calcific mass, probably calcified lymph nodes at the bifurcation of the trachea. B. Film of same esophagus taken about 45 seconds later, showing pressure at the same place but no interruption of the mucosal folds passing through the region.

Many modifications of the simple barium-water mixtures have been devised to make a medium more desirable in one respect or another. The addition of a small amount of acacia will coat the particles of barium and make for a modified colloidal suspension which will not settle out so rapidly and will have a greater tendency to adhere to the walls of the gut (1). The use of air as a double contrast medium will frequently throw the mucosal folds of the colon into sharp relief (3). In outlining the esophagus, a somewhat thickened suspension will frequently coat the walls in such a way as to outline the folds properly, but the exact concentration often depends on the individual case (4). The use of hardened boluses of gelatine-barium of graded sizes has been recommended to show the site and diameter of an esophageal stricture (2). For a time, too, thorium oxide was in use as a desirable medium

for demonstrating the mucosal pattern of the esophagus and colon (3).

In general, for specific parts of the alimentary tract and for specific conditions, special procedures have been adapted and individualized. Schatzki (4), in evaluating the difficulties of demonstrating mucosal defects of the esophagus associated with extramucosal tumors, points out that, if too much barium is given, the mucosal folds are obscured; if too little is given, the organ is not sufficiently distended, and even in the best of circumstances one must be fortunate in getting a picture that catches the bolus of barium just as it passes over the lesion.

Yet the type of lesion needing a very specialized technic for its detection is frequently the early, practically asymptomatic one—the one, in short, where a specialized technic would not be deemed necessary. The problem is especially im-

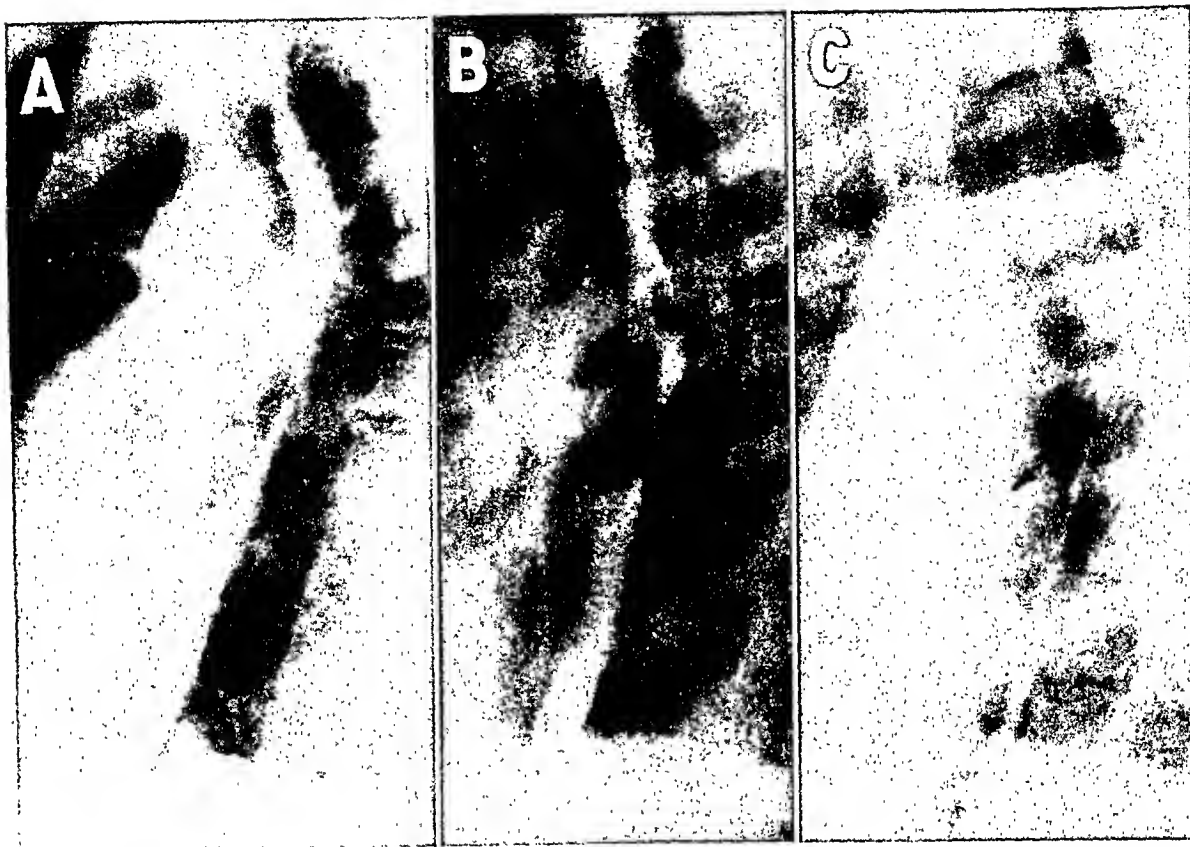


Fig. 3. A and B. Films of esophagus taken shortly after ingestion of barium-gelatin mixture, showing multiple patchy irregularities of distribution of the medium and multiple defects attributed to varicosities. C. Same esophagus about a minute after ingestion of mixture. Walls outlined by barium and lumen distended with air, showing clearly the outline of a distended varix.

portant in army practice, where few patients can have any but early lesions.

In view of these facts, it was felt that a definite need existed for a radiopaque medium which would be available, versatile enough for routine use, and at the same time capable of revealing early, slight lesions. Since a suspension of barium in water did not have the requisite properties, a search was made for a matrix for the barium which in itself would give the necessary adhesiveness and permanency of suspension. Gelatine was found to be such a material.

Gelatine will form a completely stable colloidal suspension in water over a wide range of concentrations, and barium will mix readily with such suspensions in practically all amounts. Moreover, unless they be very dilute in gelatine, such barium-gelatine-water suspensions will not settle out for long periods of time. In in-

vestigating their physical properties, it was found that the stickiness of the gelatine and its tendency to gel were relatively unaffected by the addition of the barium. Acid tended to keep the gelatine fluid, while alkali tended to solidify it. More than other acids, hydrochloric acid liquefied and digested the gelatine. Alcohol had a most profound solidifying effect on gelatine mixtures even in very low concentrations. In fact, after the addition of alcohol the barium could be mixed into a stable colloidal suspension only with difficulty.

It was realized, of course, that the gelatine would be digested in the stomach, disrupting the colloidal suspension, and that, since it is a food, it might conceivably alter gastro-intestinal motility. The time element was such, however, that the suspension should still offer some advantages in the stomach. In the esophagus after

oral ingestion and in the colon after an enema the mixture should remain stable.

Accordingly, a mixture was concocted with sufficient gelatine to give it a considerable amount of viscosity while containing enough barium to make it only semi-opaque. The technic of preparation is as follows:



Fig. 4. Normal colon study: pre-evacuation film showing colon outlined with semi-opaque medium, so that interior of gut can be partially visualized.

Two level tablespoonfuls of commercial gelatine² are added to about 1 1/2 glasses of hot water and stirred into solution. For all but very obese patients, three heaping tablespoonfuls of barium sulfate are added for oral use, or two for enema, and stirred into a fairly uniform suspension. To the resulting mixture are added 1 teaspoonful each of 95 per cent ethyl alcohol and a saturated solution of bicarbonate of soda. For oral use a

few drops of vanilla extract are added. The whole is mixed thoroughly in the standard pint-size electric barium mixer. Sufficient air will be introduced in mixing to bring the volume up to a full pint. One pint is sufficient for the routine gastro-intestinal study; for a barium enema 3 pints are usually more than sufficient. The mixture should not be allowed to solidify but is more satisfactory after a slight preliminary chilling. It is also better to use it soon after mixing, before the air bubbles have escaped.

This gelatine-barium mixture has been in routine use for gastro-intestinal series and barium-enema studies for several months at the Station Hospital of the Mississippi Ordnance Plant. Approximately 100 oral studies and 12 barium-enema studies have been made during that time.

In our experience, orally administered the mixture attains its maximum advantages in study of the esophagus. Roentgenograms and fluoroscopy of the normal esophagus will show its entire length outlined at one time. Moreover, the mucosal folds will retain the barium for at least a minute or more after ingestion, and a delayed film will reveal the mucosal pattern well outlined. It was found that much gas is commonly swallowed with the mixture and held imprisoned in the esophagus, distending the walls, which are outlined by barium. The routine adopted was to take two films in esophageal studies—one immediately after ingestion of the barium, and one about forty-five seconds later. Since the mixture is rather thin, it is of more than usual importance to have the patient correctly *angled*; otherwise the esophageal shadow will be superimposed on the cardiac or spinal shadow and be very difficult to distinguish. Figure 1A is a film of a normal esophagus immediately after ingestion of the mixture; Figure 1B shows the same esophagus a little later, with most of the barium gone and the mucosal folds outlined. Both were taken in the upright position without a Bucky. Unfortunately for an extensive study of the preparation, the patients encoun-

² Kindly donated by the Knox Gelatine Co.

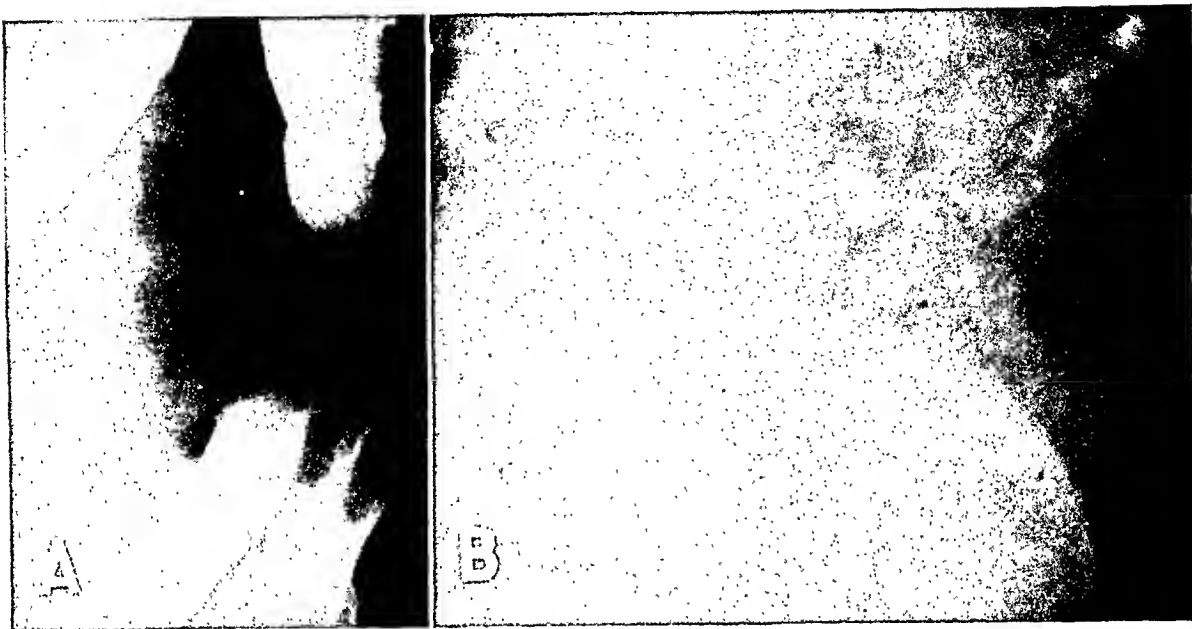


Fig. 5. Part of colon demonstrating diverticulosis. A. Pre-evacuation film showing plainly a diverticulum seen end on through gas and semi-opaque medium in the descending colon. B. Post-evacuation film, showing retained medium clearly demonstrating the multiple diverticula. Almost complete evacuation here is probably an evidence of increased irritability of the colon.

tered with esophageal abnormalities were few. Figures 2A and 2B show the esophagram of a patient with a mediastinal mass exerting pressure on the esophagus. In Figure 2B the mucosal folds show compression but no irregularity or interruption, confirming the extrinsic nature of the lesion. On the other hand, Figures 3A, 3B, and 3C show the defects in the walls of the esophagus and the distortion of the mucosal folds produced by some fairly early esophageal varices.

In the stomach the barium did not settle out as it had from simple barium-water mixtures, but the new medium probably offered no advantages over acacia-barium combinations. It was, however, quite satisfactory for routine use and proved entirely adequate for the diagnosis of the considerable number of peptic ulcers encountered. The gastric emptying time remained normal. The impression was that six-hour films show the stomach outlined with air rather more frequently than usual, but there was no adequate confirmation of this.

Films of the small and large intestines following oral administration were no better and no worse than those obtained with

other mixtures. The small and large intestinal motility was apparently unaltered.

For the barium enema, the mixture was found to be decidedly advantageous. The walls of the colon are distended but not obscured by the semi-opaque medium. After evacuation, the mixture is held with great tenacity in the mucosal folds, so that they are invariably seen. They are most completely and delicately outlined in those regions where gas has collected. In order to have even approximately complete evacuation, it is well to allow the patient more than the usual amount of time. Figure 4 is a pre-evacuation film of a normal colon. Figures 5A and 5B are pre- and post-evacuation films of a colon with multiple diverticula. A solitary diverticulum shows well in the pre-evacuation film through the window of gas and semi-opaque medium. The patients encountered were not of the age group where colonic cancer would be frequently encountered, but it is hoped that this medium may be valuable for the early detection of such lesions.

SUMMARY AND CONCLUSIONS

1. A barium-gelatine-alcohol-bicarbonate of soda medium for the routine roent-

gen-ray study of the alimentary tract has been described. The mixture is designed to afford a viscous, sticky medium containing only enough barium to make it semi-opaque.

2. In routine oral administration to 100 patients at the Station Hospital, at the Mississippi Ordnance Plant this mixture was found to outline the esophagus with better definition of the mucosal folds and for a greater length of time than other media in use, with a corresponding increase in diagnostic value. For ingestion studies of the stomach and intestines the medium was felt to be at least on a par with other available materials.

3. On the basis of 12 barium-enema studies, it is felt that the new mixture possesses distinct advantages over other preparations in outlining fully with a semi-opaque medium the colon and its mucosal folds.

4. It is therefore concluded that the preparation described is to be recommended as a versatile and reliable medium for the routine roentgen-ray examination of all parts of the gastro-intestinal tract.

Mississippi Ordnance Plant
Jackson, Miss.

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EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

The Radiation Therapist in Contemporary Medicine

The use of x-rays and the radiations of radium in the treatment of disease has come to occupy a considerable proportion of the time and energy of the practising radiologist, to such an extent, indeed, that some physicians devote themselves exclusively to radiotherapy. Within broad limits, the status of these radiations as therapeutic weapons has been firmly established though subject to constant critical survey and revision. The present-day stability of this method of treatment makes it of some interest to inquire into the function and responsibilities of the physicians engaged in its use in clinical practice.

The obvious function of the radiation therapist may be defined as the planning, management, and execution of programs of irradiation in a diverse group of diseases with the major emphasis in the field of neoplasia. The connotations of this function are several-fold and they begin, not with the execution of a therapeutic program, but with diagnostic considerations. It is important to realize that, having accepted a patient for treatment by radiation methods, the ultimate responsibility for the accuracy of the diagnosis rests on the shoulders of the therapist, even though the diagnosis has been established by special methods beyond his capacity (either by virtue of lack of training, lack of special equipment, or lack of time for dealing with such methods). Even within the more restricted field of neoplasia, radiation therapy enters into so many diverse and specialized divisions of medicine that it is evident that the radiation therapist cannot be a master practitioner in all, from either a clinical or technical standpoint. He must depend upon his specially trained

medical colleagues and must lean heavily upon the pathologist. Nevertheless, having accepted the patient for treatment, he assumes equal responsibility for the diagnosis with the colleague who has really established it.

In many instances, because of a rich experience with such material, he actually is in a better position to make the diagnosis than any other medical specialist—a fact which should not be overlooked. When this is not the case, the radiologist must none the less exercise his critical faculties in a review of the evidence upon which the diagnosis is based. Since “to err is human,” even histologic diagnoses should be reviewed for compatibility with clinical manifestations. The occasion is not infrequent when the material upon which a histologic diagnosis is made is either not representative of the actual disease or is insufficient for adequate opinion.

The radiation therapist may exert a powerful influence on diagnostic accuracy in the field of neoplasia by persistent demand for positive histologic diagnoses in the numerous instances where this involves no harm to the patient, though some inconvenience may result. A further argument for precise diagnosis is found in the fact that in malignant neoplasia radiation treatment must be vigorous to the borderline of significant damage of normal structures. This borderline is more truly a zone of indefinite boundaries and on occasion serious damage to normal tissues will complicate the picture; such an occurrence on the basis of an incorrect diagnosis is unforgivable.

The execution of a planned program of irradiation is generally accepted as the

gen-ray study of the alimentary tract has been described. The mixture is designed to afford a viscous, sticky medium containing only enough barium to make it semi-opaque.

2. In routine oral administration to 100 patients at the Station Hospital, at the Mississippi Ordnance Plant this mixture was found to outline the esophagus with better definition of the mucosal folds and for a greater length of time than other media in use, with a corresponding increase in diagnostic value. For ingestion studies of the stomach and intestines the medium was felt to be at least on a par with other available materials.

3. On the basis of 12 barium-enema studies, it is felt that the new mixture possesses distinct advantages over other preparations in outlining fully with a semi-opaque medium the colon and its mucosal folds.

4. It is therefore concluded that the preparation described is to be recommended as a versatile and reliable medium for the routine roentgen-ray examination of all parts of the gastro-intestinal tract.

Mississippi Ordnance Plant
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5. SCHLOSS, J., ETTINGER, A., AND PRATT, J. H.: Diagnosis of Diseases of the Stomach by Gastroscopic and X-Ray Relief Studies. *Am. J. M. Sc.* 193: 171-180, February 1937.



exists throughout the course of treatment, errors in treatment or management will inevitably follow.

The responsibilities of the radiation therapist do not end with the completion of the administration of radiation. Reactions must be followed to their termination; the regression or lack of regression of the neoplasm must be observed; periodically the patient must be examined to determine the presence of recurrences and metastases so that appropriate therapeutic measures may be undertaken at the earliest possible moment. Much of the follow-up work must be performed by the therapist, although, as in establishing a diagnosis, he may require aid in specialized types of examination. For certain situations his background of experience makes him more skillful than any of his colleagues in assessing the post-irradiation condition of a patient. The differentiation between recurrent neoplasm and post-irradiation sequelae is a case in point.

A larger duty rests on his shoulders than any immediate responsibility for the treatment of the individual patient. As in all fields of medicine, a portion of the progress that is achieved derives from the analysis, assessment, and criticism of clinical material and the results of clinical therapy. In the field of radiation treatment, this type of research is of considerable importance, since the underlying factor of interaction of living cells and radiation is of such great complexity as to make experimental control difficult. The primary basis for contemplated clinical investigation rests upon two factors: adequate records of the clinical, pathological, technical, and follow-up aspects of all cases and availability of the records for study.

Though little emphasis has been placed on the necessity of a mechanism for mak-

ing case material directly or potentially available, its importance should not be underrated. Many a projected clinical investigation is defeated at the outset because of the inability to recover case material of the past or is severely handicapped because, with missing cases, interpretation may be faulty. With large volume, the opportunities for losing case material increase rapidly. Some method of currently indexing or codifying case records as they pass through the hands of the radiation therapist represents an investment which should deliver rich dividends in future clinical investigation.

Radiation therapy, as practised today, cuts across the division of medicine into the various specialties. The radiation therapist, in the field of neoplasia, enters into the fields of general medicine, pediatrics, dermatology, and the multiple subdivisions of modern surgery. Because of this, he has an opportunity of acquiring a comprehensive view of neoplasia which may be denied his colleagues and he may well serve as a co-ordinating agency for tying together a store of knowledge unshackled by the limitations imposed by the classical subdivisions of medicine. In this respect the radiation therapist in many ways has a vantage point similar to that of the pathologist with, however, the inclusion of a therapeutic as well as a diagnostic point of view. His unique position in this field ably qualifies him as a valuable consultant in diagnostic and therapeutic problems, and it will be to the advantage of medical practice and progress in general if his medical colleagues recognize and utilize these consultative potentialities.

ISADORE LAMPE, M.D.
Department of Roentgenology
University of Michigan

JOINT MEETING

RADIOLOGICAL SOCIETY OF NORTH AMERICA

in conjunction with

THE AMERICAN ROENTGEN-RAY SOCIETY

Chicago, Ill., Sept. 25-29

Monday, September 25

GENERAL ASSEMBLY, 10:30 A.M.

Presiding: Sherwood Moore, M.D., President, American Roentgen Ray Society

Secretary of Session: Dabney Kerr, M.D.

1. Call to Order, SHERWOOD MOORE, M.D., St. Louis, Mo.
2. Greetings, JOSHUA J. MOORE, M.D., President Chicago Medical Society, Chicago, Ill.
3. Response, ELDWIN R. WITWER, M.D., Chairman Co-ordinating Committee, Detroit, Mich.
4. Address: A Study of the Ureters in Bladder Neck Obstructions, HERMAN L. KRETSCHEMER, M.D., President American Medical Association, and FAY H. SQUIRE, M.D., Chicago, Ill.
5. Address, Col. B. R. KIRKLIN, M.C., A.U.S., representing Major-General NORMAN T. KIRK, Surgeon-General, M.C., A.U.S., Washington, D. C.
6. Address: Pantopaque Myelography: Correlation of Roentgenological and Neurosurgical Findings, Lt. Comdr. ROBERT K. ARBUCKLE, M.C., U.S.N.R. (representing Vice-Admiral ROSS T. MCINTIRE, Surgeon-General, M.C., U. S. Navy), Lt. C. H. SHELDEN, M.C., U.S.N.R., and Lt. R. H. PUDENZ, M.C., U.S.N.R., Bethesda, Md.

DIAGNOSTIC SECTION, 2:00 P.M.

THE CHEST

Presiding: Eldwin R. Witwer, M.D.

Secretary of Session: David Beilin, M.D.

1. Progressive Bilateral Bullous Emphysema, GEORGE TEFLICK, M.D. (by invitation), and ALISON PRICE, M.D. (by invitation), Philadelphia, Penna.
2. Non-Disabling Bronchiectasis, Major ARCHIE FINE, M.C., A.U.S., National Army Air Center, Nashville, Tenn.
3. Roentgenograms of the Chest in Mental Deficiency, JOSEPH T. DANZER, M.D., Oil City, Penna.

Recess, 3:30 to 4:00 P.M.

4. Planigraphy: An Evaluation of the Method in the Diagnosis of Cancer of the Lower Respiratory Tract, J. ROBERT ANDREWS, M.D., Cleveland,

Ohio, and Capt. ROBERT O. TUREK, M.C., A.U.S. (by invitation).

5. Roentgenological Aspect of Tuberculous Calcification: A Clinical and Experimental Study, ROBERT G. BLOCH, M.D. (by invitation), Chicago, Ill.
6. Miniature Chest Fluorography with Control Study, HARRY HAUSER, M.D., and CARROLL C. DUNDON, M.D. (by invitation), Cleveland, Ohio.

THERAPEUTIC SECTION, 2:00 P.M.

Presiding: U. V. Portmann, M.D.

Secretary of Session: John S. Bouslog, M.D.

1. Value of Orchiectomy in Treatment of Carcinoma of the Male Breast, T. LEUCUTIA, M.D., Detroit, Mich.
2. Testicular Irradiation in Carcinoma of the Prostate, ARBOR D. MUNGER, M.D., (by invitation), Lincoln, Neb.
3. An Improved Technic for the Treatment of Carcinoma of the Testis, Major MILTON FRIEDMAN, M.C., A.U.S., and Lt. Col. L. G. LEWIS, M.C., A.U.S. (by invitation), Washington, D. C.

Recess, 3:30 to 4:00 P.M.

4. Review of Sixty-five Cases of Malignant Tumors of the Testes, Major J. L. BARNER, M.C., A.U.S., Atlanta, Ga.
5. Contact Roentgen Therapy for Carcinoma of the Bladder, LOWELL S. GOIN, M.D., Los Angeles, Calif.
6. Roentgen Therapy in Marie-Strümpell Spondylarthrosis (Spondylitis Rhizomelica), ROBERT J. REEVES, M.D., and JAMES E. HEMPHILL, M.D. (by invitation), Durham, N. C.

Tuesday, September 26

GENERAL ASSEMBLY, 10:30 A.M.

Presiding: Eldwin R. Witwer, M.D.

Secretary of Session: Donald S. Childs, M.D.

1. Installation of President-Elect of the American Roentgen Ray Society, LYELL C. KINNEY, M.D., by SHERWOOD MOORE, M.D., President A.R.R.S., and CHARLES H. HEACOCK, M.D., Chairman Executive Council, A.R.R.S.

2. Inaugural Address, **LYELL C. KINNEY, M.D.**, President American Roentgen Ray Society.
3. Roentgen-ray Examination of the Urinary Tract, with Special Reference to Methods and Findings in Cases of Testicular Tumors, **Lt. Col. JOSEPH C. BELL, M.C., A.U.S.**, Major **GILBERT W. HEUHLIN, M.C., A.U.S.** (by invitation), and Capt. **HOWARD J. HAMMER, M.C., A.U.S.** (by invitation), Percy Jones General Hospital, Battle Creek, Mich.
4. X-Ray Findings in Chest Examinations of 120,000 Government Employees, **WALDRON SENNOTT, M.D.**, P/A Surgeon, U.S.P.H.S., U. S. Marine Hospital, Staten Island, N. Y., representing Surgeon-General **THOMAS PARRAN, U.S.P.H.S.**
5. Radiation Necrosis of the Skull, **Comdr. JOHN D. CAMP, M.C., U.S.N.R.**, U. S. Naval Hospital, Oakland, Calif.
6. Coccidioides Infection of the Lungs, **Lt. Col. JOHN L. DAVIS, M.C., A.U.S.** (by invitation), Capt. **IVAN A. MUNK, M.C., A.U.S.** (by invitation), and Capt. **SAMUEL H. BOYER, M.C., A.U.S.**, Camp Haan, Riverside, Calif.
3. Leukemia: Results of Roentgen-Ray Treatment, **BERNARD P. WIDMANN, M.D.**, Philadelphia, Penna.
4. Experimental Production of Leukemia with X-Rays, **P. S. HENSHAW, Ph.D.** (by invitation), Bethesda, Md.
5. Some Studies with Radioactive Sodium in Leukemic and Non-Leukemic Mice, **EDITH H. QUIMBY, Sc.D.**, and **TITUS C. EVANS, Ph.D.**, New York, N. Y.
6. Metabolic Changes Produced in Man by X-Rays (to be read by title), **ANNA GOLDFEDER, M.D.** (by invitation), New York, N. Y.

CALDWELL-CARMAN LECTURE, 8:30 P.M.

Lawrence Reynolds, M.D.
Detroit, Mich.

Wednesday, September 27

GENERAL ASSEMBLY, 10:30 A.M.

Presiding: **Lyell C. Kinney, M.D.**

Secretary of Session: **Dabney Kerr, M.D.**

DIAGNOSTIC SECTION, 2:30 P.M.

THE GASTRO-INTESTINAL TRACT

Presiding: **Lyell C. Kinney, M.D.**

Secretary of Session: **Charles H. Heacock, M.D.**

1. Antral Gastritis: Roentgenologic and Gastroscopic Findings, **WALTER W. VAUGHAN, M.D.**, Durham, N. C.
2. Congenital Duodenal Obstruction, **ERNEST KRAFT, M.D.**, **FRIEDRICH G. KAUTZ, M.D.** (by invitation), and **JAMES R. LISA, M.D.** (by invitation), New York, N. Y.
3. Diaphragmatic Hernia and Dilated Esophageal Ampulla: Their Clinical Significance, **JACOB ABOWITZ, M.D.**, Los Angeles, Calif.
4. Diverticula of the Small Intestine, **MAX RITVO, M.D.**, Boston, Mass.
5. Regional Ileitis, **SAMUEL BROWN, M.D.**, Cincinnati, Ohio.
6. Differential Diagnosis Between Benign and Malignant Gastric Ulcers, **LEWIS GREGORY COLE, M.D.**, White Plains, N. Y.

THERAPEUTIC SECTION, 2:30 P.M.

Presiding: **Heddy S. Shoulders, M.D.**

Secretary of Session: **James N. Collins, M.D.**

1. Hematological and Clinical Characteristics of Leukemias, **RUSSELL L. HADEN, M.D.** (by invitation), Cleveland, Ohio.
2. Clinical and Hematological Observations on One Hundred Patients with Various Types of Blood Dyscrasias Treated with Radioactive Phosphorus, **E. H. REINHARD, M.D.** (by invitation), and **C. V. MOORE, M.D.** (by invitation), St. Louis, Mo.

1. Address, **ELDWIN R. WITWER, M.D.**, President Radiological Society of North America, Detroit, Mich.
2. Some Considerations Concerning the Roentgen Examination of the Head, **EUGENE P. PENDERGRASS, M.D.**, and **CHARLES R. PERRYMAN, M.D.** (by invitation), Philadelphia, Penna.
3. Radiological Aspects of Public Health Work, **HERMAN E. HILLEBOE, M.D.** (by invitation), and **RUSSELL H. MORGAN, M.D.** (by invitation), Bethesda, Md.
4. Roentgen Changes Associated with Pancreatic Fibrosis, **EDWARD D. NEUBAUER, M.D.** (by invitation), Boston, Mass.
5. Radioactive Sodium as a Tracer in the Study of Peripheral Vascular Disease, **BEVERLY C. SMITH, M.D.** (by invitation), and **EDITH H. QUIMBY, Sc.D.**, New York, N. Y.
6. Streamlining X-Ray Therapy for Wartime Service, Capt. **ALBERT SOILAND, M.C., U.S.N.R.**, U. S. Naval Hospital, Oakland, Calif.
7. X-Ray Demonstration of Cerebral Deformity in Amebiasis, **ROSS GOLDEN, M.D.**, and **PAUL H. DUCHARME, M.D.** (by invitation), New York, N. Y.

DIAGNOSTIC SECTION, 2:00 P.M.

THE OSSEOUS SYSTEM

Presiding: **Edgar P. McNamee, M.D.**

Secretary of Session: **Harold G. Reineke, M.D.**

1. Differential Diagnosis of Tuberculosis in Joints of the Extremities, **RAYMOND LEWIS, M.D.**, New York, N. Y.
2. Derangements of the Knee. Diagnostic Scope of Soft-Tissue Examination with the Vacuum Tech-

nic, Lt. Comdr. J. GERSHON-COHEN, M.C., A.U.S., U. S. Naval Hospital, Sampson, N. Y.

3. Post-Traumatic Para-Articular Calcifications and/or Ossifications of the Ankle, Capt. ARNOLD D. PIATT, M.C., A.U.S., Fort Myers, Fla.

Recess, 3:30 to 4:00 P.M.

Review Exhibits

4. Development of Bone Sarcoma Following Irradiation, C. HOWARD HATCHER, M.D. (by invitation), Chicago, Ill.
5. Lesions of the Intervertebral Disk in the Cervical Region, J. E. WHITELEATHER, M.D., R. E. SEMMES, M.D. (by invitation), and FRANCIS MURPHEY, M.D. (by invitation), Memphis, Tenn.
6. Roentgenographic Observations in Age Atrophy (Osteoporosis) of the Spine, G. J. MARUM, M.D. (by invitation), Greenville, Miss.
7. Deossifications Regional to Joints of Extremities, Col. A. A. DE LORIMIER, M.C., A.U.S., Memphis, Tenn.

THERAPEUTIC SECTION, 2:00 P.M.

Presiding: Robert S. Stone, M.D.

Secretary of Session: Edgar C. Baker, M.D.

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2. Roentgen Therapy of Primary Neoplasms of the Brain and Brain Stem, C. B. PEIRCE, M.D., W. V. CONE, M.D. (by invitation), A. R. ELVIDGE, M.D. (by invitation), and J. C. TYE, JR., M.D. (by invitation), Montreal, Canada.
3. Neurosurgical Treatment of Patients with Advanced Malignant Disease, GAYLE CRUTCHFIELD, M.D. (by invitation), University, Va.

Recess, 3:30 to 4:00 P.M.

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5. Roentgen Therapy of Encephalitis, U. V. PORTMANN, M.D., and ROGER LOUGH, M.D. (by invitation), Cleveland, Ohio.
6. Simplification of Tissue Dose Estimation in X-Ray Therapy, ANNA HAMANN, M.D. (by invitation), Chicago, Ill.

Thursday, September 28

GENERAL ASSEMBLY, 10:30 A.M.

Presiding: Eldwin R. Witwer, M.D.

Secretary of Session: Donald S. Childs, M.D.

1. The Morgan X-Ray Exposure Meter and Photometer, PAUL C. HODGES, M.D., Chicago, Ill.
2. Scout Film of the Abdomen, Lt. Col. JOSEPH LEVITIN, M.C., A.U.S., Camp Cooke, Calif.

3. Clinical Cineradiography: Brazilian Method, JOSÉ JANY, M.D. (by invitation), and JOAQUIN MARTINEZ GARCIA, M.D., Radiologist, Official Delegate, Ministry of Aeronautics (by invitation), Sao Paulo, Brazil.

4. Analysis of Factors Affecting the Diagnostic Quality of the Roentgen Image, RUSSELL H. MORGAN, M.D. (by invitation), Bethesda, Md.
5. Importance of Recognized Protrusions of the Gastric Mucosa in Military Personnel, Comdr. WENDELL SCOTT, M.C., U.S.N.R., U. S. Naval Hospital, Seattle, Wash.
6. Abdominal Aortography; A New Simplification of the Technic, PEDRO L. FARIÑAS, M.D., Habana, Cuba.

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Secretary of Session: W. Walter Wasson, M.D.

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2. Midline Anomalies of the Brain, ARTHUR P. ECHTERNACHT, M.D., and JOHN A. CAMPBELL, M.D. (by invitation), Indianapolis, Ind.
3. Lesions of the Aqueduct of Sylvius, HUGH WILSON, M.D. (by invitation), New Haven, Conn.
4. Tuberculous Sclerosis of the Brain, A. W., MARCOVICH, M.D. (by invitation), and EARL WALKER, M.D. (by invitation), Chicago, Ill.
5. Observations on the Presence of Subdural Gas After Pneumoencephalography, LESTER W. PAUL, M.D., and T. C. ERICKSON, M.D. (by invitation), Madison, Wis.

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Secretary of Session: Leland E. Holly, M.D.

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2. Problem of Secondary Infection in Carcinoma of the Cervix, MANUEL GARCIA, M.D. (by invitation), and J. V. SCHLOSSER, M.D. (by invitation), New Orleans, La.
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5. Bone Tumors: Review of Cases from Bellevue Hospital, New York, RIEVA ROSH, M.D., and LOUIS RAIDER, M.D. (by invitation), New York, N.Y.

BANQUET, 8:00 P.M.

Grand Ball Room

Presiding: Edward L. Jenkinson, M.D., Chicago, Ill.

FRANKLYN B. SNYDER, President Northwestern University, Chicago, Ill.

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Secretary of Session: Dabney Kerr, M.D.

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2. Subcortical Cyst-like Lesions of Joints, DALLAS B. PHENISTER, M.D. (by invitation), Chicago, Ill.
3. Cardiac Changes in Arteriovenous Fistula, Major R. C. PENDERGRASS, M.C., A.U.S., Ashford General Hospital, White Springs, Va.
4. Cystourethrography, FRED A. COE, M.D., Washington, D. C.
5. Roentgenological Aspects of Therapeutic Pneumoperitoneum, ERNST A. SCHMIDT, M.D., Denver, Colo.
6. Relaxation of Intrinsic Spasm in Pyloroduodenal Area, LESTER A. SMITH, M.D., Indianapolis, Ind.

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5. Specifications for the Fluoroscopist's Dark Adaptation Goggles, W. EDWARD CHAMBERLAIN, M.D., and ANN CHAMBERLAIN (by invitation), Philadelphia, Penna.
6. Unusual Urinary Calculi, E. J. BERTIN, M.D., Philadelphia, Penna.

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ANNOUNCEMENTS AND BOOK REVIEWS

JOINT MEETING AMERICAN ROENTGEN RAY SOCIETY and RADIOLOGICAL SOCIETY OF NORTH AMERICA

Elsewhere in this issue there appears a Preliminary Program for the Joint Meeting to be held in September. For the Radiological Society of North America this will be the Thirtieth Annual Meeting.

The requests of the various committees for contributions to the Program resulted in a most generous response, and we sincerely regret our inability to find time for formal presentation of all the papers that have been submitted.

The importance of roentgenology in the various branches of military service is evident from the many papers and exhibits coming from radiologists in the Armed Forces and various departments of the Public Health Service.

Thirty-three applications have been received for space in the Scientific Exhibits. These exhibits cover many phases in the more recent development of diagnostic and therapeutic roentgenology.

The Refresher Courses, outlined in the July issue of RADIOLOGY, offer opportunity for concentrated and specialized instruction in some of the more difficult and interesting phases of Radiology. These courses will be under the direction of highly qualified instructors.

The Commercial Exhibit gives every promise of being one of great interest. New devices, many of them resulting from experience gained in military activities, will be displayed and demonstrated.

ELDWIN R. WITWER, M.D., *President*
Radiological Society of North America

LYELL C. KINNEY, M.D., *President*
American Roentgen Ray Society

MOBILE X-RAY UNITS FOR INVASION

The following news item appearing in a recent issue of the *Journal of the American Medical Association* will be of special interest to Doctor Allen's fellow members in the Radiological Society of North America.

"After several months of experimentation the European theater of operations chief surgeon's office has announced that mobile x-ray units will follow American troops onto the continent. Lieut. Col. Kenneth D. A. Allen of Denver, who conceived the idea in 1943 and followed it through successfully, stated that the primary purpose of the mobile units, as in all medical corps work, is to keep men in the fighting front by prompt, accurate diagnosis and by location of foreign bodies and to save lives. Hospitals in the field are unable to carry enough x-ray equipment to handle peak loads of patients, so

mobile units will be rushed to them when needed. They may also be sent to clearing stations where no x-ray equipment is available. The personnel consists of one medical officer, a specialist in x-ray work and three enlisted men. Two blacked-out tents attached to a tarpaulin covering the back of the truck serve as patients' waiting rooms and picture-taking rooms. The back end of the truck is used for developing and drying x-ray films. Generators furnish power for drying film, for control of water temperature, for lighting and for powering the x-ray machine. Capt. Charles D. Rancourt of Albany, N. Y., who assisted Colonel Allen in the construction of the unit, has been demonstrating the original unit before hundreds of medical corpsmen. Colonel Allen, senior consultant in radiology to the theater chief surgeon, has been in the Army since May 1942. He taught in the x-ray school at Fitzsimons General Hospital in Denver until he went to England in January 1943."

Letters to the Editor

DYSCHESIA AND MEGACOLON

The following letter from Sir Arthur Hurst is in response to one by Dr. Percy J. Delano, appearing in the February issue of RADIOLOGY (42: 190, 1944).

To the Editor
Sir:

I have read most of the literature on intestinal disorders published in English, French, and German since 1909, and Dr. Delano is the only author I have come across who has confused dyschesia with megacolon. I should like to refer him to the second volume of Dr. Bockus's monograph on Gastro-Enterology, published this year, in which the author opens his discussion on the causes of constipation with a summary of my classification, which he accepts in its entirety. He also favours my views about megacolon, and makes extensive reference to my work on the subject.

My statement that megacolon is rare in children is borne out by the fact that one was found in only 3 out of 30,000 consecutive autopsies (Fenwick) and in only 1 in every 2,620 in-patients (Lightwood) at the Hospital for Sick Children in London. Megacolon is almost unknown in little girls, but is as common in adult women as in adult men; it is clear, therefore, that most cases in adults are acquired and not congenital.

Dr. Delano does not appear to realise that the anal sphincter actively relaxes during defaecation, and it is the absence of this relaxation (achalasia) that results in retention of gas and faeces and the development of megacolon. There is no spasm,

so no hypertrophy occurs, and the finger meets with no more resistance than is offered by the normal closed sphincter.

With regard to treatment by sympathectomy, this has now been entirely superseded in England by non-operative treatment, as it is recognized that the operation had no effect beyond mutilating a boy so that he is impotent when he grows up. The apparent benefit to the bowel condition was a result of the spinal anaesthesia. Telford, who had performed the operation more frequently than anybody else in this country, has not done it once since he found eight years ago that equally good results followed a spinal anaesthetic without any operation.

Yours faithfully,
ARTHUR HURST, M.D.

PERCENTAGE OF DISABILITY

To the Editor:

In the capacity of expert witnesses or as medical referees we are frequently asked to give an opinion as to the percentage of disability in a given case or to state the amount of physical damage resulting from the condition which we have diagnosed. Under ordinary circumstances our opinion or estimate can be little better than a guess, unless we have some definite means of computation, based upon a recognized or at least a promulgated rule.

In the course of a discussion of this subject several years ago with an unusually level-headed friend (Dr. Lucien Stark, of Norfolk, Neb.), he outlined what appealed to me as a sane and practical method of computing disability in either limb. According to this scheme the allowance is 25 per cent for each leg, 20 per cent for the left arm and/or hand, and 30 per cent for the right arm and/or hand in right-handed persons (reversing the figures if the injured person is left-handed), making a total of 100 per cent.

If the injury or defect is to the right hand, one notes what functions or forms of work usually performed by the injured person he is now unable to perform because of the disability or defect. The sum total of this disability is then deducted from 100 per cent, which represents the full use of the injured limb. Thus if in the injured right arm and hand the disability is found to be 60 per cent, leaving only 40 per cent of the normal function of the right hand, we have 18 per cent total liability. If the disability is permanent and the life expectancy is twenty-five years, the total cash settlement should be 18 per cent of the annual wages multiplied by 25.

For example: A farm hand of 35 received an injury to his right forearm, in which the ulnar nerve was severed and not sutured, resulting in a permanent contraction of the ring and little fingers. He was unable to milk, handle a pitchfork, hammer, or axe, or anything requiring the full strength and use of the right hand. Suppose we decide that he has 60 per cent disability in the right hand and arm. At 35

his life expectancy is 96 minus his age divided by 2, or roughly 30 years. He was earning \$50 per month or \$600 per year; but because of his 18 per cent disability (or only 82 per cent efficiency) his annual earning capacity is reduced permanently to \$492, or a loss of \$108. He should therefore receive \$108 per year for the rest of his life, or a lump sum of \$3,240.

I have applied this method in a few instances while acting as a referee and found that both parties to the argument agreed that the method was equitable and satisfactory. When I explained it to the jury in a recent personal injury suit, both the jurors and the judge nodded their heads approvingly and a verdict was rendered for the exact sum I had estimated, plus a liberal amount for the plaintiff's sufferings.

Yours very truly,
I. S. TRÖSTLER, M.D.

Books Received

THE PATHOGENESIS OF TUBERCULOSIS. By ARNOLD R. RICH, M.D., Associate Professor of Pathology, The Johns Hopkins University School of Medicine, Baltimore. A volume of 969 pages; 35-page index; 89 figures; 20 tables; 1417 references; 4 charts. Published by Charles C Thomas, Springfield, Ill. Price \$10.50 postpaid.

FERTILITY IN MEN. A CLINICAL STUDY OF THE CAUSES, DIAGNOSIS, AND TREATMENT OF IMPAIRED FERTILITY IN MEN. By ROBERT SHERMAN HOTCHKISS, B.S., M.D., Lieutenant Commander (M.C.), U.S.N.R. (on active service); Assistant Professor of Urology, New York University Medical College; Instructor in Surgery (Urology), Cornell Medical College; Assistant Visiting Attending, Department of Urology, Bellevue Hospital; Assistant Visiting Attending in Surgery (Urology), New York Hospital; Chief of Urological Clinic, New York University Medical College Clinic. Foreword by Nicholson J. Eastman, M.D., Chairman, Editorial Committee, National Committee on Maternal Health; Professor of Obstetrics in Johns Hopkins Hospital. A volume of 216 pages, with 95 illustrations. Published by the J. B. Lippincott Company, Philadelphia. Price \$3.50.

FERTILITY IN WOMEN. CAUSES, DIAGNOSIS AND TREATMENT OF IMPAIRED FERTILITY. By SAMUEL L. SIEGLER, M.D., F.A.C.S., Attending Obstetrician and Gynecologist, Brooklyn Women's Hospital; Attending Gynecologist, Unity Hospital; Assistant Obstetrician and Gynecologist, Greenpoint Hospital; Attending Sterility Clinic, Greenpoint Hospital; Consultant in Gynecology, Rockaway Beach Hospital; Diplomate American Board of Obstetrics and Gynecology; Fellow, New

York Academy of Medicine; Member, Society for the Study of Internal Secretions. Foreword by Robert Latou Dickinson, M.D. A volume of 450 pages, with 194 illustrations, including 40 subjects in full color on 7 plates. Published by J. B. Lippincott Company, Philadelphia. Price \$4.50.

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western University Medical School, Chicago. A volume of 780 pages, with 240 figures (293 illustrations), 72 tables. Published by Charles C. Thomas, Springfield, Ill. Price \$7.50.

EXPLORACIÓN RADIOLÓGICA DEL BRONQUIO. By S. DI RIENZO. Preface by RICHARD H. OVERHOLT, M.D. A volume of 340 pages, with 417 illustrations. Published by Sebastian de Amorortu e Hijos, Córdoba 2028, Buenos Aires.

Book Review

This volume is a comprehensive treatise on bronchography and can be recommended as a helpful text for roentgenologists and surgeons who are interested in chest diseases. Even if they are not conversant with Spanish, they will find much of usefulness in the illustrations, which are of excellent quality.

The first three chapters deal with the embryology and anatomy of the bronchial tree, and contain numerous line drawings, photographs, and bronchograms which are of unusual clarity. A chapter is devoted to the instillation of iodized oil under fluoroscopic guidance and other chapters deal with the various chronic lung diseases which are amenable to this form of examination. The illustrations show complete filling of the bronchi in the various locations with an absence of overlapping shadows which attests to a painstaking technic on the part of the author that is to be highly commended.





ADOLPH HARTUNG, M.D.
1883-1944

IN MEMORIAM

ADOLPH HARTUNG, M.D.

1883-1944

Dr. Adolph Hartung, Professor of Radiology at the University of Illinois College of Medicine, died on May 29, 1944, of coronary stenosis. He had been ill for several months and had been confined to the hospital previously for short periods with a diagnosis of coronary disease but continued to work daily, with no word of complaint until the day before his death. His stoicism and continued cheerfulness caused even his close associates to hope that his condition was not serious.

Doctor Hartung was born on Feb. 26, 1883, in Gotha, Germany. He was brought to America at the age of fifteen months, the family settling in Milwaukee. There he attended grade school and the East Side High School, after which the family moved to Chicago.

In about 1900, Doctor Hartung became a demonstrator and salesman for the Scheidel X-ray Company with a territory extending from Michigan to Oklahoma. He demonstrated the new-found rays at the St. Louis Exposition in 1904. His interest in medicine stimulated, he entered the College of Physicians and Surgeons (later the University of Illinois) and was graduated in 1908. To meet the expenses of his education, he served as an apprentice in a pharmacy and later passed the examination for licensed pharmacist, though he had never attended a pharmacy class.

After a short period of general practice, Doctor Hartung decided to specialize in radiology and was successively radiologist to the Alexian Brothers, Grant, Cook County, and University of Illinois Research and Educational Hospitals. He served the latter institution from its inception in 1925. In 1909 he became associated with the University of Illinois College of Medicine as an instructor in the Division of Roentgenology of the Department of Medicine. He was made its first Professor of Radiology in 1925 and head of the department in 1927.

Doctor Hartung was a charter member of the Chicago Roentgen Society and served as president of that organization for two terms. He was also a Fellow of the American College of Radiology, a member of the American Roentgen Ray Society and of the Radiological Society of North America, and a diplomate of the Board of Radiology.

Conservative in diagnosis and therapy, he was an avid reader, ever alert for new methods or equipment. Commanding a wealth of clinical material, he limited his writing to what he considered

worth-while contributions and despised what he called "re-hash" articles. A prodigious worker, Doctor Hartung lived with enthusiasm, his informal social manner belying his impressive professional appearance. He was granted the wish he often expressed and died "with his boots on."

T. J. WACHOWSKI, M.D.

H. KENNON DUNHAM, M.D.

1872-1944

After practising medicine for nearly fifty years, Dr. H. Kennon Dunham died in Cincinnati on April 27, 1944, from coronary thrombosis occurring in the course of convalescence from bronchial pneumonia. He served and inspired others to serve and left a lasting mark in the fields of his chosen endeavor.

Doctor Dunham was born in Fairview, Ohio, in 1872. He was graduated from the Miami Medical College, Cincinnati, in 1894, and did postgraduate work at Johns Hopkins (1896), at Great Ormond Street and St. George's Hospitals, London (1899), and at the University of Wisconsin (1915-17), where he was associated with Dr. Wm. Snow Miller and Dr. Henry Bunting. He early became interested in the application of x-rays to the diagnosis of intrathoracic lesions and subsequently limited his practice largely to the diagnosis and treatment of chest diseases, more particularly tuberculosis. He was Associate Professor of Medicine and head of the Department of Tuberculosis in the University of Cincinnati and from 1914 to 1940 was Medical Director of the Hamilton County Tuberculosis Hospital.

Doctor Dunham was President of the Cincinnati Academy of Medicine in 1921, President of the Ohio Public Health Association in 1930-32, and President of the National Tuberculosis Association in 1934-35. He was a diplomate of the Board of Radiology and of the Board of Internal Medicine, Fellow of the American College of Physicians and of the American College of Radiology, and a member of the American Clinical and Climatological Association, American Association of Thoracic Surgery, American Trudeau Society, American Roentgen Ray Society, and the Radiological Society of North America.

Doctor Dunham served in the First World War as Captain and Major and was active in the rehabilitation work of the Veterans Bureau. His son, Harry, was killed in the present war while on service in New Guinea.



H. KENNON DUNHAM, M.D.
1872-1944

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

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The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

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Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Note on the First Demonstration of an Intracranial Foreign Body by Roentgen Rays. Cobb Pilcher. *J. Nerv. & Ment. Dis.* 99: 71-73, January 1944.

The author records an interesting incident in early American radiologic history, giving credit for the first radiograph for an intracranial foreign body to Dr. Wm. Stubenbord. The examination was performed before the Brooklyn Medical Society on June 19, 1896, with use of a Crookes tube and a galvanofaradic machine. The plate was immediately developed and presented to the Society. An illustration shows the bullet shadow in the orbit. An account of the case was published in the Brooklyn Medical Journal (10: 737, December 1896). LESTER M. J. FREEDMAN, M.D.

THE CHEST

A Comparative Study of Chest X-Ray Survey Methods. Arthur B. Robins. *U. S. Nav. M. Bull.* 41: 1036-1040, July 1943.

The author conducted a comparative study of mass chest x-ray survey methods as applied to the examination of large numbers of civil employees in a navy yard. Factors considered were accuracy, expense, time required, and convenience. Fluoroscopy was discarded as being time-consuming to the operator and subject and failing to produce a permanent record. As no commercial contract service was available using 4 × 5-inch photofluorography, this method was also eliminated. The choice thus fell between roll paper film and 35-mm. fluorography.

Sixty selected subjects were examined by both methods, with additional full-sized celluloid films. Four radiologists were given the films for interpretation, the celluloid films being assessed last. All abnormalities were noted on the records, and no comparison between the different types of films was made until the entire reading was completed. Each physician's own interpretation of the 14 × 17-inch celluloid film was used as his basis for comparison. Only parenchymal lesions such as reinfection tuberculosis, calcified primary tuberculosis, or pneumoconiosis were considered in the scoring. A lesion was considered missed if it was described on the celluloid film but not identified on either or both of the survey films, or if it was described on one side in the survey film and both sides in the 14 × 17-inch celluloid film.

On the 35-mm. film, 20.9 per cent of the lesions were missed, while on the paper film only 1.2 per cent were missed. On 7.1 per cent of the photofluorograms and 3.3 per cent of the paper films, lesions were described which were not confirmed on the corresponding celluloid films. As overreading necessitates re-examination with consequent loss of production time, the latter figure is deemed significant.

ELLWOOD W. GODFREY, M.D.

X-Ray Diagnosis of the Non-Tuberculous Chest. Francis L. Simonds. *Nebraska M. J.* 29: 4-8, January 1944.

The author stresses the value of the roentgen examination and its proper interpretation in the diagnosis of

diseases of the chest. He describes his method of study of a flat roentgen film in which each lung field is arbitrarily divided into three vertical zones: an inner, middle, and peripheral zone. The inner zone contains the root or hilum shadows. The middle zone contains the trunk shadows, gradually fading out into their final subdivisions. The peripheral zone contains radiating lines or linear markings and the parenchyma. These linear markings are the ultimate trunk shadows, and they gradually fade away in their final divisions before the periphery is reached.

Diseases of the chest are divided into four major groups: infections, tumors, circulatory disorders, and irritations. The roentgen appearances of several lesions are described and illustrated.

HENRY K. TAYLOR, M.D.

Non-Tuberculous Pulmonary Cavitation. Louis Nathanson and Philip Morgenstern. *Am. J. Roentgenol.* 51: 44-52, January 1944.

In an analysis of 2,000 autopsies at Sea View Hospital, New York, on patients with cavitory lesions in the lungs, involving all lobes, Auerbach (personal communication to the authors) found approximately 1.5 per cent with non-tuberculous cavities. The percentage must be higher in non-tuberculous or general hospital autopsy material.

A series of case histories is presented illustrating some of the lesions which produce cavitation and simulate a cavitating tuberculous process. X-ray cavities in silicosis may be produced by emphysematous blebs, lung abscesses, or necrosis of silicotic areas. Cavitation in silicosis does not always indicate silicotuberculosis. A case of cystic bronchiectasis with one large cyst and numerous smaller cavities of the right lung is described. Pneumonectomy was performed on this patient. A case of actinomycosis of the lungs is presented in which patchy infiltration with several highlights suggesting cavitation were seen. Autopsy revealed multiple actinomycotic abscesses.

In another patient a large sacular aneurysm of the descending thoracic aorta had invaded the left lower lobe and produced a large cavity. There was no tuberculous involvement of either lung. Bronchogenic adenocarcinoma was proved to be the cause of cavitation in another instance. A chronic pyogenic abscess in an upper lobe may occur. Repeatedly negative sputum examinations will prove decisive in differentiation from a tuberculous cavity. Bronchiectasis involving the upper lobes is indistinguishable clinically from chronic pulmonary tuberculosis. The absolute limitation of the process to one lung is of the greatest importance in differentiating these lesions. Fibroid tuberculosis usually will show some infiltration in the opposite lung (Wessler and Jaches: *Clinical Roentgenology of Diseases of the Chest*, Troy, N. Y., Southworth Co., 1923).

Winn (*Arch. Int. Med.* 68: 1179, 1941) has recently reported 12 cases of pulmonary cavitation associated with coccidioidal infection. Occasionally a gumma may cavitate centrally and simulate tuberculosis. In children one may find cysts or bleb formation in association with pneumonias, suggesting a tuberculous lesion.

CLARENCE E. WEAVER, M.D.

Lower Lobe Bronchiectasis Associated with Tuberculosis. E. B. Mitchell and T. F. Thornton. *Am. Rev. Tuberc.* 49: 38-47, January 1944.

It has been generally accepted that bronchiectasis limited to the lower lobe is non-tuberculous. The authors report five cases in which lower lobe bronchiectasis was found to be associated with tuberculosis. These cases represent about 5 per cent of the cases of bronchiectasis seen in the University of Chicago clinics during the last ten years. The diagnosis of tuberculous bronchiectasis involving a lower lobe is not easily made, probably because it is not often suspected. In two of the five patients examination of the sputum showed tubercle bacilli and there were histories of recent tuberculosis. The features that lead to a suspicion of tuberculosis are: (1) suggestive history; (2) roentgenological evidence of apical tuberculosis; (3) bronchoscopic finding of bronchial stenosis; (4) unilateral or unilateral bronchiectasis. The diagnosis can be made with certainty only if a positive sputum is obtained, and careful sputum examination should be stressed in all cases of bronchiectasis. The main etiologic factor appears to be a tuberculous bronchitis with stenosis. The knowledge that tuberculosis is present in a case of lower lobe bronchiectasis is of importance when surgical resection is considered. Surgical intervention should not be undertaken without regard for the added risk of lobectomy in the presence of active tuberculosis but is indicated when the symptoms of bronchiectasis are sufficiently severe and no active tuberculosis is present elsewhere in the lung.

L. W. PAUL, M.D.

Postoperative Pulmonary Collapse in Childhood. Clement J. Molony. *Am. J. Dis. Child.* 66: 280-301, September 1943.

Twenty-one cases of postoperative atelectasis taken from the records of the Children's Memorial Hospital in Chicago and the Los Angeles Children's Hospital, for the ten year period 1931 to 1941, are presented. As the author points out, there is a much lower incidence of postoperative collapse in a children's hospital than in a hospital for adults, since surgical intervention in the upper part of the abdomen is less frequent in childhood and because children are not kept so immobilized and narcotized as adults.

The diagnosis of postoperative atelectasis is based on the rather sudden onset of cough, fever, and dyspnea in a child who has been operated on a day or so earlier. There are suppression of breath sounds, dullness, and usually rales and signs of consolidation over the involved area of the lung. The roentgenogram shows a shadow corresponding to a collapsed lobe or to collapsed lobes; the leaf of the diaphragm is high on the involved side, and usually the heart is shifted toward the side of the collapse. Collapse of the upper lobe may or may not pull the heart toward the lesion.

The etiologic factors for collapse following surgical procedures are discussed, and precautions against and treatment for postoperative atelectasis are suggested. The main objective of treatment is to help the patient cough out the secretions. This is best done by change of position. Potassium iodide or ammonium chloride may be given to liquefy the secretions. In cases in which such measures are ineffective, bronchoscopic drainage should be instituted without too great delay. Even in properly treated cases bronchiectasis may develop. Brief histories of the 21 cases are included.

Primary Atypical Pneumonia. An Analysis of Therapeutic Results in 155 Cases. Howard L. Correll and Irving I. Cowan. *U. S. Nav. M. Bull.* 41: 980-987, July 1943.

The authors report their clinical experiences and therapeutic results in 155 unselected cases of atypical pneumonia. The month to month incidence did not fluctuate with the incidence of upper respiratory infections and showed no significant seasonal variation. Radiographic findings were generally more advanced than the physical signs. The pneumonia was confined to one or both lower lobes in 92.8 per cent and involved the upper lobe or 3 lobes in the remainder. Migration or extension of the pneumonic process was observed in 12.6 per cent of the patients who were followed by serial x-rays, while resolution was delayed beyond thirty days in 14.5 per cent of the same group.

Seventy-two patients were treated by routine methods; 41 were given sulfathiazole and 10 sulfanilamide; 23 received x-ray therapy consisting of 112 roentgens measured in air (100 kv., 5 ma., 25 cm. target-skin distance, 2 mm. aluminum added filtration, with a half-value layer of 3.6 mm. of aluminum) to the involved area. This dose was repeated in twenty-four hours if the clinical response was not satisfactory. Those treated routinely ran a fever for an average of 6.8 days and required an average of 23.4 days for clearing as demonstrated by x-ray films. The patients treated with sulfathiazole ran a fever for an average of 6.5 days and required an average of 21.2 days for clearing, while those treated with sulfanilamide ran a fever for an average of 6.4 days and required 20.0 days to clear. The acute cases treated with irradiation ran a fever for an average of 3.8 days only and required an average of 8.3 days to show clearing roentgenographically. Nine patients with unresolved pneumonia who had been ill for an average of 33.3 days received similar x-ray therapy. Subsequent to this therapy the lesions showed radiographic evidence of resolution in an average of 4.0 days.

ELLWOOD W. GODFREY, M.D.

Roentgenological Types of Pulmonary Lesions in Primary Coccidioidomycosis. Justin R. Colburn. *Am. J. Roentgenol.* 51: 1-8, January 1944.

Coccidioidomycosis is caused by inhalation of dust-borne chlamydospores of the fungus in its vegetative stage. The symptoms usually consist of dry cough, chest pain, malaise, fever, weight loss, and night sweats. Five to 20 per cent of the patients may develop erythema nodosum or multiforme. Gradual recovery is the rule. Resolution of the pulmonary lesions is often prolonged weeks after the patient is clinically well. In an extremely small percentage of cases the highly fatal chronic disseminated granuloma stage develops, apparently as endogenous "reinfection."

The author's material consisted of 75 soldiers admitted to the Station Hospital, Camp San Luis Obispo, California, during the favorable dry, dusty season. In 29 or 38.7 per cent of these cases infiltrative fan-shaped densities were observed roentgenographically, extending from prominent hilar shadows. This picture resembles bronchopneumonic inflammation with a minimum of consolidation. Resolution is slow, averaging forty days. Hilar densities without evidence of significant peripheral bronchial or parenchymal involvement were observed in 24 per cent of the group studied. Peripheral lobular and sublobular exudates

and infiltrates were found in 26.6 per cent. When the upper lobes were affected, the lesions resembled minimal "reinfection" tuberculosis. Demonstrable cavitation occurred in 3 cases (4 per cent). Two of these healed; the third one persisted as a cyst-like excavation. Two patients had massive pleural effusion without evidence of parenchymal infiltration.

Production of a variety of pulmonary lesions by *Oidium coccidioides* is well explained by the possible state of balance of three important factors: individual resistance, dosage of the infecting organism, and allergic status of the host. A fourth factor may be time, or the intervals between succeeding repeated infecting doses in relation to ascending allergy of pulmonary tissues. Indications of a predominantly proliferative reaction with a minimum of fibrosis are found in the characteristic course of the disease. Permanent fibrotic residues are not conspicuous. Calcification of healed caseated tracheobronchial lymph nodes has been observed. Inconclusive roentgenographic evidence was considered to be present in only 3 cases of this series.

The most constant roentgen finding is hilar shadow confluency, widening and increased radiopacity. The most valuable diagnostic roentgen criterion is delayed but fairly complete resolution, placing the disease midway between "acute" and "chronic" in the scale of pulmonary inflammations.

CLARENCE E. WEAVER, M.D.

Bagassosis: A Case Report. S. Chaille Jamison, Margaret Strange Bryan, and Jane Matthews Day. *New Orleans M. & S. J.* 96: 291-294, January 1944.

A 32-year-old negro gave an occupational history of eight months' exposure to sugar cane grindings. The occupational period was divided into two periods: (1) seven months of exposure to damp cane grindings, followed by (2) one month of exposure to dry bagasse. Symptoms—cough, weakness, malaise, dyspnea—developed only after exposure to the dry dust. A roentgen examination of the chest revealed a diffuse miliary type of infiltration throughout both lung fields with enlarged hilar lymph nodes. Follow-up roentgenograms showed progressive but not complete resolution of the lesion during a five-month period. Clinical symptoms disappeared in less than four weeks following cessation of exposure to bagasse dust.

HENRY K. TAYLOR, M.D.

Etiology of Erythema Nodosum. Peter Kerley. *Brit. J. Radiol.* 16: 199-204, July 1943.

The most widely held theory of the etiology of erythema nodosum is that it is an allergic reaction to bacterial and chemical toxins. Many believe it to be a manifestation of tuberculosis. Against these theories are the facts that it is largely confined to the Nordic races, that it has a seasonal incidence, that it occurs in small epidemics in schools, barracks, and factories, and that it is limited to certain age groups—chiefly two to ten and eighteen to thirty years. The pulmonary lesions and the lesions at the hilum seen by x-ray do not resemble tuberculosis. The rapid appearance and disappearance of the lesions is also inconsistent with that disease.

The behavior and appearance of the lesions of erythema nodosum as observed in the author's series of 37 cases—all in adults—resemble the known be-

havior and appearance of sarcoidosis. The radiological findings are identical. In 2 cases, skin lesions excised after the acute rash had disappeared showed the histologic characteristics of sarcoids. In 2 others, eye lesions strongly suggestive of sarcoidosis developed. The history of fatigue as the sole symptom in association with extensive visceral changes is also typical of sarcoidosis, as is the absence of physical signs with massive bronchial node enlargement. Absence of splenic enlargement and changes in the phalanges in the series reported are against sarcoidosis, but not all cases of the latter disease show these changes, and they may be present without radiologic evidence.

The author hesitates to draw definite conclusions on the basis of 37 cases, but he does believe that the evidence presented indicates that those patients with erythema nodosum with obvious visceral manifestations are suffering from sarcoidosis. Erythema nodosum may, indeed, be two diseases, distinguished by the presence or absence of such manifestations.

SYDNEY J. HAWLEY, M.D.

Laminagraphic Studies of the Aorta: Their Advantages and Limitations. Wendell G. Scott and Donald S. Bottom. *Am. J. Roentgenol.* 51: 18-28, January 1944.

The laminagraph of Kieffer and Moore was used by the authors in their studies of the aorta. It is well suited for the examination because, by employment of the spiral movement, all the unwanted shadows are blurred out. The left anterior oblique position is used for demonstrating the ascending portion of the arch of the aorta. The laminagram is usually made at a level opposite the right anterior axillary line. For showing the descending portion of the arch of the aorta and the descending thoracic aorta, the left lateral position is used. These laminagrams are made at levels 2 to 4 cm. lateral to the spinous processes. Conventional roentgenograms, made first, indicate the most advantageous level in a given case.

In children and young adults, sectional roentgenography is not of much advantage. In patients fifty years of age and older, arteriosclerotic changes have developed to various degrees and sectional roentgenography is of value. The aortic wall is more dense and there is a marked spread in the distance between the ascending and descending aorta.

An important but seldom recognized complication of advanced arteriosclerosis of the aorta is the development of a dissecting aneurysm. In this condition there is usually a sudden onset of severe pain in the middle of the thoracic back, upper lumbar spine, and left chest. Lateral sectional roentgenograms will show a marked increase in the width of the aortic arch and the proximal descending thoracic aorta. Three such cases are described, with reproductions of the roentgenograms showing the enlarged aortic shadows. These could not be properly demonstrated on conventional roentgenograms.

Sectional roentgenography can be employed with equal effectiveness in visualizing sacculated thoracic aortic aneurysms. It also has occasionally been helpful in distinguishing between aneurysms and mediastinal tumors.

The main advantages of body section roentgenography of the aorta are that the examination is simple and can be done by a technician, and it is not uncomfortable or hazardous to the patient.

CLARENCE E. WEAVER, M.D.

Pneumohydropericardium. Report of Three Cases. Richard A. Kern and Ellwood W. Godfrey. U. S. Nav. M. Bull. 41: 1001-1011, July 1943.

The authors report 3 cases of pneumohydropericardium occurring in a series of 75 cases of traumatic pneumohydrothorax. In all three instances the air and fluid in the pericardial sac were believed to have gained access through a pericardial tear resulting from a sudden and violent shift of the mediastinum.

The diagnosis and treatment are briefly discussed. The authors point out that the physical signs and roentgenologic findings of pneumohydropericardium are dependent upon two factors: (a) the presence or absence of adhesions that might determine the location and the mobility of air and fluid in the pericardial sac; (b) the relative amounts of air and fluid present. The more air and the less fluid, the greater the likelihood that a mill-wheel murmur be heard and that excessive motion of the heart shadow be seen fluoroscopically.

ELLWOOD W. GODFREY

THE DIGESTIVE SYSTEM

Effect of Motion on the Roentgenographic Appearance of the Stomach and Small Bowel. Francis E. McDonough and Martin Schucider. Gastroenterology 2: 32-45, January 1944.

One hundred healthy males between the ages of 19 and 35 were tested by roentgenographic studies for susceptibility to motion sickness. Before testing, each subject drank 2 oz. of barium sulfate suspended in 250 c.c. of water. No attempt was made to regulate the time of testing in relation to food or fluid intake. Observations were made by fluoroscopy in 19 and by roentgenograms in 81 cases. The fluoroscopic observations were made while the subject drank the test meal and continued long enough to enable the fluoroscopist to record the size, shape, position, tone, peristaltic activity, evidence of pylorospasm, and beginning emptying of the stomach. The subject then underwent testing on the motion-producing device. At the completion of the motion test, he returned to the fluoroscopic room and the changes from the pre-motion appearance of the stomach, as well as the appearance of the small intestine, were noted. In the roentgenographic studies the same sequence was maintained.

Twenty-eight of the 100 subjects were classified as having become "sick" and 72 as "immune," *i.e.*, without signs or symptoms of motion sickness. Eleven of the 72 well subjects and 5 of the 28 "sick" subjects showed poor gastric tone before testing, indicating that this does not predispose to motion sickness. Gastric peristalsis was present before testing in 54 of the "immune" subjects and 22 of the "sick" subjects. After testing, only 12 of the "immune" subjects (16.6 per cent) showed a decrease in peristalsis as compared with 16 (57 per cent) of the "sick" subjects. Forty-eight of the "immune" and 11 of the "sick" subjects showed no change with testing in either gastric tone or peristalsis. Thirteen (46.4 per cent) of the 28 "sick" subjects as compared with 6 (8.3 per cent) of the 72 "immune" subjects showed a decrease in both gastric tone and peristalsis, *i.e.*, over 5 times as large a proportion of "sick" subjects as of "immune" subjects, a highly significant difference. Of the "immune" subjects 27.8 per cent and of the "sick" 21.4 per cent had pylorospasm before testing; the corresponding figures

after testing were 31.9 per cent and 42.8 per cent, which indicates that changes in the occurrence of pylorospasm bear no relationship to the occurrence of "sickness."

No significant difference in the type of change of intestinal progress of the barium meal was observed in the two groups.

In 47 of the 100 subjects very little or no barium appeared in the duodenum or proximal jejunum after testing, although barium was present in the stomach, distal jejunum, and ileum. The authors term this condition the "interval pattern" and found no apparent relationship between its occurrence and "sickness" and "immunity." It apparently occurs secondary to motion and can be called an effect of motion, but the mechanism is unknown.

The authors conclude that there is no specific type of gastro-intestinal tract, either from an anatomic or functional standpoint, which is associated with motion sickness susceptibility.

Life Cycle of Carcinoma of the Stomach. Report of Three Interesting Cases of Carcinoma of the Pylorus. Maurice Feldman. Gastroenterology 2: 60-64, January 1944.

Three closely parallel cases, illustrating the life cycle of carcinoma of the stomach, are presented. Repeated roentgen examinations were made in each case, over a number of years, enabling the author to study the sequence and progress of the growth from the onset to its final stage. The clinical picture was that of peptic ulceration with periods of remission. The roentgen findings were similar in all three instances—narrowing of the prepylorus involving both curvatures, fixation of the curvatures, with a plateau appearance of the lesser curvature in the affected area. Growth was slow, extending over many years. Two of the patients had persistent low gastric acidity, while one showed a hyperacidity throughout the entire course of the illness. In each case there finally developed a pyloric obstruction due to an inoperable carcinoma.

Negative roentgen findings on gastric examination often give a sense of false security. The demonstration of a narrowing of the pylorus suggests a possible lesion. In spite of a negative gastro-intestinal study, an organic lesion somewhere in the alimentary tract should be suspected in a patient with a digestive disorder who is clinically getting worse or is not improving. Under these circumstances repeated interval roentgen studies are indicated.

A series of roentgenograms illustrates each case report.

Hypertrophic Pyloric Stenosis in Adults. J. Edward Berk and Harold J. Dunlap. Ann. Surg. 119: 124-133, January 1944.

Some hundred odd cases of simple pyloric muscle hypertrophy in adults have been reported in the literature and there are, no doubt, numerous unrecorded examples. The authors present two additional cases, in each of which a psychogenic factor may have played a role.

One patient was aged thirty-seven and the other thirty-nine. Both were males and had been inducted into the Army several months before reporting to the hospital for examination. Both showed evidence of personality dysfunction and both had experienced serious domestic and financial problems in civil life.

Each gave an "ulcer-like history occurring in conjunction with symptoms and signs of partial to complete pyloric obstruction," and in each a roentgenogram showed the narrowing of the antrum and pylorus, with intact mucosa, and invagination of the base of the duodenal cap that have been described as characteristic of pyloric muscle hypertrophy. In each case a subtotal gastrectomy was done. Histopathologic study showed, in addition to the hypertrophy of the pyloric muscle, an associated gastritis, though preoperative gastroscopy had revealed no mucosal abnormalities.

The authors believe that in cases such as theirs complete reliance for diagnosis on the operative findings alone is a practice fraught with danger. The inability to exclude a malignant growth in these cases justifies gastric resection rather than a simple palliative procedure even though one may strongly suspect that the mass is composed only of hypertrophied muscle.

G. A. CREEL, M.D.

Congenital Atresia of the Duodenum and of the Ileum: Report of Two Cases with Successful Results Following Operation. Edwin M. Miller, Joseph Greengard, William B. Raycraft, and Irma McFadden. *Am. J. Dis. Child.* 66: 272-279, September 1943.

A successful outcome in a case of congenital atresia of the ileum, as in congenital obstruction of the duodenum, demands early diagnosis and prompt surgical intervention. The prospects in obstruction of the ileum are less favorable, however, than in duodenal atresia. Left alone for more than two or three days, the rapidly distending, completely obstructed small bowel undergoes progressive degenerative changes leading to necrosis, and too often operation is delayed to the point where actual peritonitis has already set in.

Vomiting, beginning immediately after birth, is the outstanding symptom of obstruction of either the duodenum or the ileum. When the obstruction is in the ileum, the vomitus is at first composed of stomach contents, then is stained with bile and rapidly becomes brown and has a fetid odor. If it remains constantly biliary, it is quite likely due to obstruction of the duodenum. The lower part of the abdomen is relatively flat with duodenal atresia, but with atresia of the ileum becomes progressively distended and yields a tympanitic note on percussion. Roentgen findings are of the greatest importance. A plain film will show clearly the distended stomach and duodenum or the several loops of distended small bowel. Practically no air can be visualized in the colon. If a barium enema is given, the collapsed state of the entire large bowel can be easily made out.

Two cases of congenital atresia of the ileum, in which successful operations were performed, are reported, with details of the surgical technic.

Roentgen Study of Lymphogranuloma Venereum: Report of Twenty-Four Cases. I. Klein. *Am. J. Roentgenol.* 51: 70-75, January 1944.

Lymphogranuloma venereum appears first in males as a minute erosion or papule on the penis or prepuce; in females the infection is carried not to the inguinal nodes but to the wall of the rectum. Symptoms of rectal and colonic involvement are tenesmus, constipation, and mucous and bloody stools. The disease is chronic, sometimes running a course of twenty years or more. Roentgen studies show a destruction of the mucosa, rectal strictures, distention of the rectal pouch,

single and multiple perirectal and perisigmoid sinus formation, and fistulous tracts. Roentgenograms are furnished, showing tubular narrowing of the rectum, extensive rectosigmoid narrowing with perianal sinuses, annular stricture of the rectosigmoid simulating cancer, and extensive narrowing involving the rectum, sigmoid, and descending colon.

Lymphogranuloma venereum is occasionally mistaken for cancer. Cancer, however, is of shorter duration. Lesions of lymphogranuloma venereum begin in the anal region, while cancer tends to develop in the rectum. Cancer, on roentgen examination, shows an irregular shadow protruding into the lumen. Lymphogranuloma venereum shows more often a regular shadow. In cancer, the rectum below the stricture, down to the anus, will show normal mucosal folds. This will not be the case in lymphogranuloma venereum. A sinus tract is common in lymphogranuloma venereum and is unusual in cancer.

Ten of the author's series of 24 cases were in males, all of whom had inguinal scars or palpable nodes. Seventeen of the 24 patients were Negroes.

On account of certain characteristics which can be shown definitely by roentgen examination, it seems advantageous to use the x-ray as an aid in establishing the diagnosis and extent of this disease.

CLARENCE E. WEAVER, M.D.

Cholecystography and Jaundice. Frank Huber. *Am. J. Roentgenol.* 51: 12-17, January 1944.

The experience of various observers with cholecystography in the presence of jaundice is reviewed. The author's report is based on the findings in 50 unselected cases of jaundice which were submitted to cholecystography by the intensified oral method. No deleterious effects due to the procedure were noted. Eleven out of 15 cases with common duct stone showed "no shadow" of the gallbladder; faint gallbladder shadows were seen in 4 cases. Two of 3 cases of cholecystitis without cholelithiasis showed faint shadows. The second largest group (11 cases) had no final diagnosis; a very faint shadow was obtained in a single instance, while the other 10 cases showed no shadow. In 10 cases of toxic and infectious hepatitis good shadows were obtained in 7 and faint shadows in 3 cases. In 3 cases of cancer of the common duct a faint shadow appeared in 1, no shadow in 2.

In cases in which jaundice is decreasing, a patent common duct is predicated and the same diagnostic criteria are used as in patients without jaundice. In these cases cholecystography may well be deferred. With increasing jaundice, diagnostic information is usually not obtained, since apparently no difference exists in the degree of impairment of dye excretion whether due to back pressure (extrahepatic biliary obstruction) or to parenchymatous disease, either toxic, infectious, cirrhotic, or neoplastic.

CLARENCE E. WEAVER, M.D.

Emphysematous Cholecystitis. C. A. Stevenson. *Am. J. Roentgenol.* 51: 53-60, January 1944.

Emphysematous cholecystitis may be defined as an acute infection of the gallbladder characterized by gas production in the lumen and walls and the pericholecystic tissues. Any virulent gas-producing organism may produce the disease when favorable circumstances exist. Roentgenographic demonstration of this condition is rare.

Of the various microorganisms which have been found in the gallbladder and its walls, *B. welchii* is the one most likely to produce gas under anaerobic conditions. The most probable sequence of events in the production of the disease is lodging of a stone in the cystic duct, with resulting decrease in the local resistance of the gallbladder tissues, allowing avirulent *B. welchii* to become virulent, followed by production of gas in the gallbladder, emphysematous blebs in the loose areolar tissue of the gallbladder wall, and extension of the infection to the pericholecystic tissues.

Three cases are reviewed. These gave roentgenographic evidence of gas in the gallbladder lumen, emphysematous blebs in the wall, and collections of gas in the pericholecystic tissues. Two of the patients were operated upon and recovered. No intensive effort to demonstrate *B. welchii* was made. The third case was treated with sulfathiazole, *B. welchii* anti-serum, and roentgen therapy. This patient also recovered.

The presence of gas in the gallbladder lumen alone is not sufficient for the diagnosis of emphysematous cholecystitis, for patients with biliary fistulae commonly show gas in the gallbladder, either with or without gas in the biliary duct system.

CLARENCE E. WEAVER, M.D.

Diaphragmatic Hernia. J. Edmund Bradley and D. James Greiner. *Am. J. Dis. Child.* 66: 143-149, August 1943.

A case is reported of the rare type of true congenital diaphragmatic hernia on the right side with a portion of the liver as the only content of the hernial sac.

The patient, a white boy, appeared normal at birth, but at the end of the second week it was noticed that his respiration seemed unusually rapid. He was first seen by the authors at the age of seven weeks. At this time the respiratory rate was greatly accelerated, with a pronounced retraction of the interspaces with each respiration. There was a definite bulging of the right anterior portion of the chest wall. The nail beds of the fingers and toes appeared slightly cyanotic. The trachea was deviated to the left. The heart was percussible to the left anterior axillary line. Heart sounds were normal. There was a pronounced impairment of the normal resonance in the right anterior portion of the chest, with hyperresonance on the left. The breath sounds throughout the right side of the chest anteriorly were extremely distant, and numerous crepitant and subcrepitant râles were heard. Posteriorly the breath sounds were absent.

Roentgen examination showed the heart and great vessels to be pushed to the left and an area of increased density in the right lung extending from the fourth rib to the diaphragm and from the hilus to the outer zone of the lung. The impression was that this area represented a fluid-containing cyst or tumor of the lung. An exploratory tap was done and air alone obtained. Because of the age of the patient, operative intervention was postponed.

Roentgen examinations at approximately monthly intervals revealed no change from the condition shown on the original roentgenogram. The child gained weight and seemed to experience no particular distress. At the age of five and a half months, on Jan. 2, 1941, the patient was admitted to the hospital for operation, but before this was attempted, a lobar pneumonia developed in the upper lobe of the left lung. The immediate

response to sulfapyridine therapy was good but several days later an upper respiratory tract infection occurred, followed by a disseminated pneumonia. Death ensued Feb. 16, 1941.

Autopsy revealed bronchopneumonia of the left lung. The right lung showed only rudimentary development and was adherent to and compressed by a rounded solid mass which rendered it completely atelectatic. This mass consisted of a portion of the right lobe of the liver and the gallbladder covered by a thin fibrous membrane which could be reflected in a glove-like manner after the diaphragm had been freed. The membrane was a defective portion of the diaphragm which formed a hernial sac with an opening measuring 4 cm. in diameter.

Survey Film Diagnosis of Acute Surgical Abdomen. Samuel Levine and Leon Solis-Cohen. *Surg., Gynec. & Obst.* 78: 76-82, January 1944.

The authors review the advantages of survey films of the abdomen in most of the common and in many of the unusual surgical conditions, including intestinal obstruction, ruptured viscera, tumors and abscesses causing mass effects, thrombosis, trauma, and ruptured aneurysm. Films are described as much more accurate than fluoroscopy, and various postures and projections must be used to secure the most information. Thus, in the presence of free fluid or air in the peritoneal sac, not only the supine but also the upright or lateral decubitus exposures must be made to demonstrate air and fluid levels. Another item worthy of attention is that positive findings increase in many of the cases of ruptured viscera as the interval between rupture and examination increases, thus demonstrating the necessity for repeated studies.

The statement that free air beneath the right leaf of the diaphragm is pathognomonic of a ruptured hollow viscus must be modified when it is recalled that some rare exceptions to this occur in abscesses produced by gas-forming bacteria. The authors urge the inclusion of observation of the diaphragm and of the lower chest as an aid to diagnosis of the abdominal state.

Among the more interesting conditions described is splenic rupture, creating displacement of the stomach and colon, and showing roentgenographically a serrated outline of the greater curvature of the stomach and marked gastric dilatation. Of interest, also, is an instance of obstruction with gastrectasia in a case of tuberculous adenitis of the retroperitoneal nodes near the duodenum.

EDWIN L. LAME, M.D.

THE SKELETAL SYSTEM

Growth of Major Long Bones in Healthy Children: A Preliminary Report on Successive Roentgenograms of the Extremities from Early Infancy to Twelve Years of Age. Marion M. Marsh. *Am. J. Dis. Child.* 66: 227-257, September 1943.

Serial roentgenograms of the left arm and leg were taken on a group of 113 healthy children, 52 girls and 61 boys, at semiyearly intervals up to twelve years of age. Six hundred and seventy-one sets of these form the basis of this study. The lengths of the humerus, radius, ulna, femur, tibia, and fibula obtained from these roentgenograms were used, without correction for distortion, in the study of rates of growth of these bones

and of correlations between the lengths of the bones and skeletal growth.

The roentgenographic technic was kept as constant as possible with children of such different ages. A 7 1/2-foot (228.6 cm.) focus-film distance was used throughout to reduce the distortion to a minimum. High-speed screens were employed, with the result that some of the finer details of bone structure were sacrificed in the interest of speed. Infants were held in position with the arm or leg flat against the cassette in an anteroposterior position, while the older children stood on a platform with the arm or leg in contact with the surface of the cassette. Exposures were made with 100 ma. and as short a time as was feasible. For infants one-twentieth of a second and 65 to 75 kv. were found to be adequate. For older children, time and voltage varied from one-tenth to nine-twentieths of a second and from 60 to 75 kv.

The measurements were made in the simplest possible manner, the greatest possible length of the shaft being taken along the long axis of the bone from epiphyseal line to epiphyseal line. All measurements were made and checked by the same person.

The author does not attempt to draw any certain or far reaching conclusions from this preliminary study but presents the method as a reliable technic in the study of growth. Numerous tables and charts are included showing the different types of growth curves, the ratio of length of each long bone to total body stature, etc. Increase in length of the bones on successive measurements indicates that the growth rate, at least up to the age of ten years, is remarkably orderly. Some sex differences are suggested. An approximate straight relationship between the length of one bone and that of another was found, with high coefficients of correlation. High correlation coefficients were also found between stature and lengths of the bones. An essential straight line relationship between these measurements exists after approximately six months of age, but prior to that time, lengths of the bones are proportionately greater in relation to stature than they are at later ages. Thus, in the early postnatal months it is probable that the trunk is growing in length at a faster rate than the rest of the axial skeleton.

X-Ray Appearances of Bone in Yaws. Carl H. Goldmann and Stephen J. Smith. *Brit. J. Radiol.* 16: 234-238, August 1943.

Yaws is of radiologic interest chiefly in the tertiary stage, which is the stage in which skeletal involvement occurs. The observations presented here are based upon 101 cases (selected from 185) in which the diagnosis was established beyond clinical doubt.

Yaws (and by yaws the authors mean tertiary yaws) affects chiefly the extremities in the following order of frequency: tibia, fibula, femur, and ulna. During the active stage of the disease, as early as four weeks after the appearance of clinical symptoms, small oval islands of destruction appear in the compact bone. The periosteum is not affected until there is some destruction in the adjacent cortex.

Untreated, the disease gradually progresses into the inactive stage. The bone thickens, mainly at the expense of the marrow space. The compact bone loses calcium, and streaks of decalcification like fibrils are visible on the inner and outer borders. The bone may remain this way for many years. In some instances the changes progress to resemble "marble bones" and

the bone becomes abnormally brittle. Bowing occurs and fractures are common. Much the same changes occur in treated cases but development into an inactive stage is hastened.

The patient with yaws of the spine presents the clinical picture of an infectious spondylitis. Radiographically the bone is eburnated. There may or may not be round central areas of destruction like gummata within the compact areas. Bony bridges are common.

The differential diagnosis from syphilis is difficult but important and takes on added significance in the African troops in the British Army, since the prognosis of yaws is favorable but a syphilitic African is a "doubtful risk." The chief differential point is the rapid response of yaws to specific treatment. It is unusual for syphilis to attack the bone and leave the periosteum unscathed, as occurs in yaws, which affects the compacta and involves the periosteum only if the foci are very superficial. Acute osteomyelitis also calls for differentiation, but patients with that disease are much sicker than those with yaws. Tuberculosis usually shows more bone destruction than yaws, but in children the differentiation may be impossible.

SYDNEY J. HAWLEY, M.D.

Radiological Appearances of Bone in Cases of Tropical Ulcer. J. A. Brocklebank. *Brit. J. Radiol.* 16: 221-224, August 1943.

Tropical ulcer should not be confused with "tropical sore," which is a manifestation of leishmaniasis. Tropical ulcer is a sloughing ulcer of unknown cause common in the tropics. It may occur anywhere on the body, but is more common on the feet and legs. The course is chronic, continuing for many months, and the disease is resistant to treatment. Ultimate scarring may be severe and deforming. Death sometimes occurs from secondary infection.

About half of the patients show no skeletal changes radiologically. The earliest observed bone change is a periostitis at the ulcer site. This slowly progresses to an osteoperiostitis and ultimately to osteomyelitis.

Differential diagnosis must be made from the bone lesions of syphilis and yaws. This is difficult and may depend finally on the result of treatment.

SYDNEY J. HAWLEY, M.D.

Unusual Osseous Disease with Neurologic Changes: Report of Two Cases. Conrad M. Riley and Harry Shwachman. *Am. J. Dis. Child.* 66: 150-154, August 1943.

Two unusual yet similar cases in which bizarre osseous changes and hyperreflexia were outstanding features are presented by the authors in the hope that other cases will be reported and a greater understanding of the condition may be attained. The patients were a girl and a boy, each approximately five years of age. Each had a peculiar gait, which was characterized by a straight leg, a wide base, and a calcaneus limp; neither child could run. Ankle clonus and hyperreflexia were present in both children. One child showed extreme anorexia, with emaciation; the other showed anorexia only. Both were easily fatigued.

Roentgenographic examination of the girl showed alterations in the midportions of all the long bones, with fusiform swelling and areas of relatively increased density and mottled areas of decreased density. There

was generalized poor mineralization, with slight coxa valga deformity of the hips. The skull showed no abnormalities. The bone age was within normal limits. A biopsy of bone and muscle revealed no evidence of an inflammatory process; there was an increase in density of cortical bone and minimal evidence of bone resorption. Some atrophy of the skeletal muscles was noted. This case had been followed at the time of the report for one and one-half years. Later roentgenograms of the long bones showed the change in the shafts to be more pronounced, suggesting a continuation of the process. The deep tendon reflexes were not nearly so active as when the patient was first seen.

In the case of the boy, roentgenograms revealed changes both in the long bones and in the skull. In each femur, beginning about 1 inch proximal to the epiphysis and extending about 4 inches up the shaft, was a smooth fusiform dilatation of the shaft. The bone in this area was of generally increased density, but there were scattered areas of decreased density. There was a valgus deformity of the head of each femur. The tibiae and fibulae showed an abnormal area of irregularly thickened cortex at each end of the diaphysis. A similar lesion involved the entire middle part of the shaft of each of the bones of the arm. In the femurs it was also noted that there was a little periosteal reaction over the swellings. The bones at the base of the skull showed a fairly pronounced increase in density. The bony contours, including the foramen magnum, were essentially normal. In the pelvis there was a small, rounded shadow apparently produced by bone and demonstrated by intravenous pyelograms to be outside the genito-urinary tract.

Two Cases of Osteochondral Hypothyroidism. R. Hermon. *Brit. J. Radiol.* 16: 208-211, July 1943.

Two cases of osteochondral hypothyroidism are presented. The recent literature covering this condition, Perthes' disease, and other osteochondral dysplasias is reviewed. The contention of Schaefer and Purcell that Perthes' disease is a manifestation of hypothyroidism (*Am. J. Surg.* 54: 589, 1941. *Abst. in Radiology* 39: 374, 1942) is questioned, and the importance of its differentiation is stressed. Osteochondral hypothyroidism responds readily to thyroid therapy, and if the hypothyroid component is discovered, the treatment period can be shortened and the final results improved. In Perthes' disease, on the other hand, prolonged immobilization may be necessary if deformity is to be avoided.

The value of general skeletal study in all cases is emphasized. In osteochondral hypothyroidism retardation of osseous development is the rule, and apparent bone age is an approximate indication of the severity of the condition. The appearances of the different epiphyses are protean, varying from a slight granular lack of homogeneity to a coarse or fine stippling or fragmentation with or without coherence. The condition is bilateral, usually more or less symmetrically so, and there is often multiple epiphyseal involvement. The changes are most characteristic and usually most marked in the femoral capital epiphyses, where, in addition to the fragmentation, a line of cleavage dividing the epiphyses into inner and outer halves is often observed. This probably represents a pressure splitting of the relatively brittle bony epiphysis. There is a greater tendency to pressure splaying of the diaphyseal extremity of the femoral neck than in

Perthes' disease, and in untreated cases the degree of deformity so produced may be extreme. The fragmented epiphysis adapts itself to the altered shape of the femoral neck, but in cases where diaphyseal molding is not marked the epiphysis does not usually show the degree of flattening that is seen in a case of untreated Perthes' disease. SYDNEY J. HAWLEY, M.D.

Pellegrini-Stieda Disease. Morris Reingold and James W. Nellen. *U. S. Nav. M. Bull.* 41: 800-811, May 1943.

Eight cases of Pellegrini-Stieda disease are reported. The authors believe that the calcification characteristic of this condition is due to a metaplasia of the soft parts and is not of periosteal origin, since in all of their cases a clear space was demonstrable radiographically between the internal femoral condyle and calcified crescentic mass.

There is a history of trauma in all cases. In the typical case there are no roentgen findings for at least three or four weeks following injury. Subsequently a mottled, fuzzy, indistinct shadow, indicative of recent origin, may appear. A clear-cut, sharply outlined deposit is characteristic of the "stabilized" form.

Treatment is generally unsatisfactory, as pain tends to recur with slight trauma. In 2 of the authors' cases intensive roentgen therapy was used with no apparent effect on the course or symptomatology. Physical therapy produced no demonstrable improvement in 3 additional patients. In 2 cases the disease was discovered when a routine radiographic examination was ordered after the applicants for commission gave a history of severe trauma to the knee but denied any pain or disability since the original injury. In one case the disease was incidental to a traumatized meniscus. ELLWOOD W. GODFREY, M.D.

Significance of Some Developmental Abnormalities of the Hip Joints. Eric Samuel. *Brit. J. Radiol.* 16: 250-254, August 1943.

The failure of proper development of the acetabulum in congenital dislocation of the hip is well known. The minor failures and abnormalities of development are less commonly recognized. Their recognition is, however, important both for grading the patient's fitness for military service and because of the frequency with which osteoarthritic changes supervene in later life.

Films should be taken with the patient supine, the medial sides of the balls of the great toes together and the heels two inches apart. Both hips should be included for the sake of comparison.

Congenital subluxation of the hip joint may be recognized as a failure of complete development of the acetabulum, permitting slight displacement of the head of the femur. The acetabulum appears shallow. The lower portion of the joint space is wide and the upper portion narrow. The head appears to be partly out of the socket. There may be an apparent coxa valga, but this is due to rotation of the femur rather than a true deformity. Another type of congenital subluxation is seen when there is a disproportion between the femoral head and acetabular fossa, the latter being too small to accommodate the former. In these cases there is a tendency for the acetabulum to form a false lower lip.

Other deformities that may be recognized are an abnormally deep acetabulum and protrusio acetabuli. Cases of deep acetabula are more common than fully

developed cases of protusio acetabuli, and careful examination of the radiograph is necessary if minor increases in acetabular depth are not to be overlooked. The radiograph shows the femoral head abnormally engaged in the acetabular fossa. These deformities may produce pain on long marching and some limitation of motion.

SYDNEY J. HAWLEY, M.D.

Humero-Radial Synostosis. E. Frankel. *Brit. J. Surg.* 31: 242-245, January 1944.

Humero-radial synostosis is a rare abnormality occurring in conjunction with other deformities of the limbs. The affected arms are shortened and in the majority of cases the deformity is accompanied by a rudimentary ulna and a faulty development of the carpal bones and fingers. Twenty-two cases have been reported, and in the majority the condition was unilateral. In all cases the humerus continues into the radius without a change in the structure of the bone.

The author's patient was a man aged 23, who had a chronic nephritis and died following a severe suppurative parotitis. He had a bilateral humero-radial synostosis and his elbows were flexed at slightly less than a right angle. There was marked wasting of all the muscles of the arm normally used in movements of the elbow, due to disuse atrophy. The left patella was absent. The right patella was small and on flexion of the knee was displaced laterally over the condyle of the femur. A roentgenogram of the right elbow showed complete absence of the joint space. The ulna was small and was fused with the humerus.

The family history in this case is of particular interest. The patient was one of seven children, four of whom showed the same deformity and abnormalities of the patellae and knee joints. Since neither father nor mother was similarly affected and since recessive hereditary factors appeared not to be involved, the author assumes a germinal change in one of the parents, or at least a germinal re-arrangement, leading to the production of the new characters.

MAX CLIMAN, M.D.

Chronic Osteomyelitis of the Skull. Hans Brunner. *Ann. Otol., Rhin. & Laryng.* 52: 850-894, December 1943.

Brunner classifies chronic osteomyelitis of the skull as primary and secondary in type.

The primary type is characterized chiefly by its insidious onset and its slight tendency to spread. An abscess may take from ten days to several months to develop and usually forms a persistent sinus following incision and drainage. Ordinarily, there is minimal fever, no leukocytosis, and little local pain. Spread of the disease process follows the blood vessels, rarely penetrates the dura, and eventually results in sequestrum formation over a period of months or years. Cure is effected by removal of the sequestrum.

When the frontal sinus is involved, abscess formation is extremely slow, with toxemia affecting the nervous and gastro-intestinal tracts; severe headaches develop and there is gradual formation of exostoses. There may be hyperplasia of the nasal mucosa with the presence of nasal polypi and pus. Fistulous tracts may break through from the frontal sinus into the nasal cavity. X-ray examination in chronic sinusitis shows the fuzzy appearing and sclerotic sinus boundaries due to the superficial osteitis. In osteomyelitis, the disease

process has passed through the compacta, so that on the roentgenogram the outlines of the sinus not only may be indistinct but may disappear altogether; and due to the thickening of the anterior wall, replacement of the frontal sinus by sclerotic bone occasionally prompts an erroneous report by the radiologist of congenital absence of the sinus. Cases of primary chronic osteomyelitis with involvement of the frontal sinus that progress to fistula and sequestrum formation are best treated by the Riedel operation. Cases with thickening and sclerosis of the walls are a more difficult problem. The clouding seen on the roentgenogram is due to the disease process within the sinus walls, and irrigation is therefore of no value. Operation by the Riedel or Kuhnt technic is worth while for relief of pain and toxemia. The Kuhnt operation usually results in less deformity.

Seven detailed and illustrative case histories are presented with special attention to the operative technic. Etiological factors in this group were erysipelas of the scalp, scarlet fever, head injury, adenocarcinoma of the paranasal sinuses with subsequent obstruction of both naso-frontal ducts, and pansinusitis.

Chronic osteomyelitis of the secondary type is initially an acute osteomyelitis which gradually passes into a chronic phase. There is slow but progressive extension of the process within the bone with marked tendency to spread by way of the blood stream, producing a chronic septicemia and metastatic abscesses. Multiple sequestra frequently form, containing parts of the lamina externa and diploe but usually no lamina interna.

The pathogenesis of the two types of chronic osteomyelitis is essentially the same. Osteoclasia and osteogenesis are both present, the latter predominating, sequestra being formed on the one hand and thickening with sclerosis on the other. In the primary type, the sclerosis is usually found in the frontal sinuses, spreading very gradually peripherally, while in the secondary type, the frontal sinus may clear while sclerosis and sequestra are found in distant parts of the skull such as the vault, malar bone, or wings of the sphenoid.

Treatment of secondary chronic osteomyelitis is very unsatisfactory because of the widespread disease of the bone, the multiple metastases, and the septicemia. The sulfonamides have given some measure of relief. The important point is prevention of the development of acute osteomyelitis into the chronic form.

Infection of the paranasal sinuses was the responsible factor in the 4 cases here presented as typical of the secondary type of chronic osteomyelitis of the skull.

LESTER M. J. FREEDMAN, M.D.

Epidermoid (Squamous Epithelial) Bone Cyst of Phalanx. H. F. Pohlmann and M. Wachstein. *Am. Surg.* 119: 148-154, January 1944.

Only 10 proved cases of epidermoid cyst of the phalanx could be discovered in the literature. In all there was a history of previous injury. Two patients were adolescents and the ages of the others were between twenty-nine and fifty years. The symptoms most often encountered were pain and tenderness with swelling and redness of the part.

The roentgenologic finding is a distinct area of destruction in the terminal phalanx. This translucent area is homogeneous, fairly well circumscribed, and

more or less circular. In one instance the cystic area showed vacuolation and in another two confluent cysts were found. The lesion is usually centrally located, but occasionally may be eccentric. A thin shell of bone may remain or this may be destroyed, with a resultant pathologic fracture.

Enchondroma is the lesion most likely to be confused with an epidermoid bone cyst. Trabeculation of the cystic space with small areas of increased density, when present, is indicative of the former diagnosis. Simple bone cysts occur usually in younger patients (before the age of twenty) and seldom cause symptoms before fracture occurs. They are rare in the phalanges, as are giant-cell tumors.

At operation the picture of epidermoid cyst is characteristic—a white, glistening wall and sebaceous-like contents. Microscopic examination shows the cyst wall to be made up of stratified squamous epithelium. None of the cysts has shown dermal structures.

Treatment may consist of amputation of the phalanx or operative removal of the cyst followed by cauterization of the bony cavity. Operative removal is the method of choice since this preserves the phalanx and may be repeated if there should be a recurrence.

The authors report a case of typical epidermoid cyst in a man of fifty, following injury. A roentgen diagnosis was made and the cyst was removed with subsequent cauterization of the bony cavity.

G. A. CREEL, M.D.

Compound Fronto-Orbital Fractures (Eight Cases). J. Schorstein, Brit. J. Surg. 31: 221-230, January 1944.

This is a report of 8 cases of compound fracture of the frontal bone with involvement of the frontal and ethmoidal sinuses in 7, the exception being a child, in whom the frontal sinuses had not yet developed. The author is convinced of the necessity for early and extensive operation in these cases, before the development of intracranial infection. All of the patients had scalp wounds containing in their depths the broken fragments of the walls of the paranasal sinuses. Operation was performed in 6 cases and in all of these the dura had been torn and in 4 the brain was severely lacerated. All these patients recovered satisfactorily. The 2 remaining patients were seen ten days and five months, respectively, after the occurrence of the injury, and recovery was delayed and complicated by meningeal sepsis. The disfigurement following these injuries is considerable and bone-grafting should not be too long postponed in uncomplicated cases. Bone grafts were used in 4 of the present series. Detailed case reports with illustrations are included.

The anatomy and mechanism of the injuries are well described. The extent to which the anterior fossa may be pneumatized not only varies within wide limits from case to case, but the right and left halves may present striking differences. In operating on the sinuses from above, the distinction between the posterior parts of the frontal and ethmoidal cavities is difficult to establish, particularly when comminuted fractures have opened both.

Two types of fronto-orbital fractures were seen in this series. In one, the fragments were multiple, irregular, and wedged. In the other, the depressed fragment was large and had the shape of a segment of a circle.

MAX CLIMAN, M.D.

Fractures and Dislocations of the Cervical Spine. F. Crooks and A. N. Birkett. Brit. J. Surg. 31: 252-265, January 1944.

The authors review a series of 59 cases of cervical spine injury (fractures and dislocations) from hospitals in an industrial area. Industrial accidents accounted for the largest number, with road accidents next in frequency. The cases are classified in groups according to the type of fracture.

Group 1. Spinous Process Fractures: There were 6 cases of fracture of the spinous processes, involving either the 6th or 7th cervical vertebra or both. They are due either to direct violence or to muscle pull.

Group 2. Transverse Process Fractures: There was only one case of transverse process fracture, involving the 7th cervical vertebra.

Group 3. Fractures of the Main Vertebral Substance and Fracture-Dislocations and Dislocations: There were 3 cases of fracture of the atlas in this group. These were isolated fractures and all involved the posterior arch. X-ray evidence showed that union of this type of fracture takes place readily. There were 2 cases of displacement of the atlas on the axis. There was no gross paraplegia in either instance. Fracture of the odontoid occurred in 4 cases, with forward displacement in 3 cases and backward displacement in 1.

The axis was fractured or displaced on the 3rd vertebra in 6 cases. In one of this number there was injury of the cord with Brown-Séquard syndrome and fatal outcome. The ultimate function in the 5 remaining cases was excellent. The author gives a clear description of the anatomical structure at this level with an explanation of the mechanism of this type of fracture.

There were 7 cases of "more or less pure" compression fracture with no cord or root injury. Two cases are described, both of which were caused by diving into shallow water. Each was treated by traction and subsequent plaster collar with good results. Prognosis in compression fractures is excellent. Successful reduction restores normal vertebral contour and the disks are not affected.

There were 10 cases of fracture-dislocations and subluxation, fracture when it occurred being of secondary importance. Permanent injury was done to the soft tissues, disks, ligaments, joints, and muscles. The pathological changes resulting from this type of injury were either synostosis of adjacent vertebral borders or a narrowing of the disk space associated with progressive tipping of the anterior margin of the vertebrae. The functional results in the 8 cases which were traced were good; 2 patients having nerve root lesions at the onset still complained of some pain in the arms after several years. The authors warn of the danger of designating these injuries simply as subluxation on the x-ray evidence.

Dislocation with locking facets occurred in 8 cases. Reduction is attempted by traction of the neck by halter and countertraction on the legs under a general anesthetic. There was a complete paraplegia from the onset in 5 of the authors' series, with fatal outcome, and one death from hypostatic pneumonia.

Injuries to diseased spines are placed in a separate subgroup because of the probability that the bony changes present in the neck must have rendered the patient more vulnerable to injury. There were 12 cases in this group, 10 of which showed changes typical of osteoarthritic spondylitis, while the other 2 exhibited

complete ankylosis as a part of a general ankylosing spondylitis. Only 2 of the 10 patients with osteoarthritic spondylitis showed any displacement of the bones. In some of the cases the radiologists reported no lesion except arthritic changes: yet there were 8 cases of complete or incomplete paraplegia, with 6 deaths. On 2 occasions at postmortem examination a torn disk and ligaments were discovered, allowing fairly complete abnormal displacement of the bones. These cases are difficult from the radiological point of view, for apart from muscle spasm the neck tends to be stiff and is difficult to examine roentgenographically. The level of the injury may be determined alone by the level of the lesion of the spinal cord, but x-ray evidence of co-existing fracture of an isolated spinous process is helpful.

Two examples of fractures in men suffering from late stages of ankylosing spondylitis occurred. In one case the radiographs revealed a fracture through the ossified intervertebral region between the 3rd and 4th cervical vertebrae without displacement. The second case showed complete ankylosis of the spine from axis to sacrum with a fracture in the region of the 7th cervical with gross anterior displacement on the 1st dorsal. In both cases there was an associated paraplegia with fatal outcome.

MAX CLIMAN, M.D.

Compression Fractures of the Vertebral Bodies and Other Changes Mistaken for Them. John D. Ellis. *J. Bone & Joint Surg.* 26: 139-145, January 1944.

The most frequent site of compression fracture of a vertebral body is the lower thoracic and upper lumbar region, since it is here that the point of greatest pressure occurs and the interspaces are wider than elsewhere.

In the act of flexion, the first part of the motion occurs through the axis of the nucleus pulposus until its resilience is exhausted; the axis of motion is then shifted to the joints of the arches. This mechanism accounts for the compression affecting the entire superior surface of the body, resulting in a wedge-shaped deformity. The greater deformity of the anterior portion of the body is due to the slight amount of anterior motion permitted at the zygapophyseal joints and to the rolling action of the nucleus pulposus. The inferior surface is less often compressed, probably because of the cupping of this surface, permitting the force to be distributed evenly over the surface by the nucleus pulposus.

The determination of compression is made by drawing parallel lines along the superior and inferior surfaces of the vertebral body. In the normal vertebra these should form an angle of 90 degrees with the posterior surface of the body. In compression fractures, the superior surface is affected alone or to a much greater degree than the inferior surface.

The consensus of opinion seems to be that spondylitis and osteophyte formation in the spine do not result from compression fracture of the vertebrae.

Scheuermann's node is a small triangular portion of bone that appears separated from the anterosuperior edge of the vertebral body and is probably due to failure of complete calcification of the cartilaginous end plate. This condition can hardly be confused with fracture. Juvenile osteochondritis of the vertebra or Scheuermann's disease presents a wedging of the vertebral body, but here the superior surface is affected only slightly more than the inferior, the bone

edges are irregular, the surfaces of the adjacent bodies are possibly affected, and the location is most commonly in the lower thoracic region.

JOHN B. McANENY, M.D.

Fractures of the Triquetrum. J. Grant Bonnin and W. P. Greening. *Brit. J. Surg.* 31: 278-283, January 1944.

Direct injury to the triquetrum is rare owing to its protection by the overhanging end of the ulna. Indirect injury, however, is relatively common, accounting for 3.5 per cent of all wrist injuries. Two forms may be distinguished: (1) injuries by compression and (2) ligament traction or sprain fractures. Oblique views in addition to the anteroposterior and lateral views are necessary for diagnosis. A slightly oblique view throws the shadow of the triquetrum a little above that of the lunate and allows distinction to be made between the two.

Compression injuries take the form of subperiosteal fractures with little displacement, or areas of depression of cortex and lamellae corresponding to the point of maximal pressure. Associated with compression fractures of the triquetrum are posterior marginal fractures of the radius, with a comminuted fracture of the tubercle and fractures of Colles type with anterior dislocation of the lunate and fracture of the pisiform.

The more common ligament traction fractures occur in excessive palmar flexion, the posterior tubercle of the triquetrum being separated by the pull of the ligaments from the body of the bone. Most frequently the fragment is seen lying parallel with the dorsum of the carpus. The small flake of bone frequently remains ununited and can be seen in the lateral view of the wrist, resembling a sesamoid in the extensor tendons. The organized lower surface of the flake enables it to be distinguished from a recent injury. Avulsion of the tubercle is also seen in association with the less common fracture of the posterior pole of the lunate. In these cases radiographs reveal loss of continuity of the line of the lunate and two lines of compact bone in the avulsed fragment. This fracture may readily be confused with fracture of the tubercle of the triquetrum.

MAX CLIMAN, M.D.

Avulsion Fractures of the Fibula. Morris I. Bierman. *U. S. Nav. M. Bull.* 41: 647-652, May 1943.

The differentiation between a simple sprain of the fibular collateral ligaments and chip fracture of the fibular malleolus is important since the latter is indicative of a complete giving way of the ligament at its point of attachment and, unless adequately treated, may result in instability of the ankle joint.

The usual x-ray technic will not demonstrate an avulsion of the fibulocalcaneal ligament with tearing off of a small fragment of bone. The author, in addition to the usual anteroposterior and lateral views, recommends a third view. The patient lies prone upon the x-ray table and a sandbag is placed under the ankle. A cardboard film holder is inserted between the foot in plantar flexion and the sandbag (if the film holder extends below the toes no increase in pain is felt). The central ray is directed toward the head at an angle slightly greater than 90° with the dorsum of the foot. The anterior margin of the fibula or point of origin of the anterior and medial fasciculus of the fibular collateral ligament is well demonstrated by this

technic. When a bone fragment is torn off, the rays pass between the fragment and the fibula, and the fracture is easily seen.

ELLWOOD W. GODFREY, M.D.

March Fractures. Baxter L. Clement. *J. Bone & Joint Surg.* 26: 148-150, January 1944.

The author examined 32 cases of march fracture in a group of soldiers whose training period averaged eleven weeks.

Routine roentgenograms consisted in anteroposterior and oblique views of the foot. An oblique view was found to be necessary to determine a very early march fracture, the change appearing as a faint nick extending proximally through the cortex of the metatarsal shaft. No transverse fracture line was seen.

The left foot was involved twenty times and the right foot twelve times. Only the second and third metatarsals were affected, the second in 17 cases and the third in 15 cases. About 75 per cent of the fractures were in the distal or middle third of the shaft. In all but 3 cases the fracture line appeared on the medial aspect of the shaft.

On close examination of the cases, the second and third metatarsals were found to be longer than the first metatarsal in all but two instances. It is suggested that this may be a predisposing factor to the occurrence of march fracture, due to the greater weight-bearing falling on the longer bones. It is believed that a metatarsal pad applied at the first complaint of pain, even before a fracture line is evident, will shorten the period of disability. JOHN B. McANERY, M.D.

March Fracture. Report of a Case Involving Both Fibulae. A. Scott Hamilton and Howard E. Finklestein. *J. Bone & Joint Surg.* 26: 146-147, January 1944.

A case of march fracture involving both fibulae, occurring in a soldier, is reported. The authors agree with Camp and McCullough (*Radiology* 36: 651, 1941) that this entity probably does not represent a new disease but is simply the response of the weight-bearing skeletal frame to continuous overstrain.

THE GENITO-URINARY TRACT

Renal Cysts, Simple and Otherwise. Wm. F. Braasch and John A. Hendrick. *J. Urol.* 51: 1-10, January 1944.

This presentation reviews clinical and therapeutic data in 163 cases seen at the Mayo Clinic in which simple cysts of the kidney were found at operation.

Simple cysts, usually filled with clear serous fluid, are benign and seldom cause clinical complications such as occur with polycystic disease. In the majority of cases, one cyst of relatively large size is present, together with varying numbers of smaller ones. They are often found bilaterally. The presence of a cyst may often be surmised urographically, but the deformity of the renal pelvis frequently presents a problem in differential diagnosis from other renal or extra-renal lesions.

Simple cysts are of clinical significance only when they become large or numerous enough to disturb renal function or when they are discovered upon physical or urographic examination. The usual size of the cyst, in this series, was from 5 to 10 cm. in di-

ameter. The size varies widely. The location was stated in all but 21 of the cases reviewed here. Of those for which the site was given, 23 per cent were in the upper pole, 68 per cent in the lower pole, and about 8 per cent in the central portion of the kidney.

Simple renal cysts are a disease of adult life, 75 per cent of the cases occurring in the fifth, sixth, and seventh decades. Most of the patients suffered no acute pain, but in some there was a dull ache or dragging sensation in the lumbar region or upper abdominal quadrant. Many of the patients were aware of an abdominal tumor, and the authors, upon physical examination, noted its presence in 86 per cent of the cases. Displacement of the kidney, due either to pressure from or weight of the cyst, was noted in 42 cases. Normal renal function tests do not exclude the presence of simple cysts. Hypertension is seldom seen as a direct result of simple renal cyst; it was present in only 3 cases in this series.

Urography, either excretory or retrograde, was performed in all but 13 patients. It offered the best and simplest method of diagnosis. Evidence of deformity was found most frequently in the calices, where details were usually better visualized by retrograde pyelography.

Differentiation of the deformity caused by the simple cyst from that due to a renal or extra-renal neoplasm may often be difficult. Whenever any possibility of a malignant growth exists, the authors believe that the patient should have the benefit of surgical exploration so that an accurate diagnosis can be reached. Aspiration of cysts for diagnosis is usually unsatisfactory.

Other types of renal cyst mentioned in this paper are the multilocular, peripelvic, and parapelvic. The first is nothing more than a large cyst subdivided by numerous partitions. Peripelvic cysts may be directly connected with the renal pelvis and some cause recurring pain due to secondary infection, with eventual stone formation. Parapelvic cysts are situated adjacent to the renal pelvis; they may be of congenital or perirenal lymphatic origin. NATHAN P. SALNER, M.D.

Post Caval Ureter. Carl L. Wilson and Jacob Herzlich. *J. Urol.* 51: 14-18, January 1944.

The authors report a case of retrocaval ureter found at operation. Medical literature records only 27 examples of this anomaly. Preoperative diagnosis was made in only one instance. Present opinion states that the fault lies in the abnormal embryologic development of the inferior vena cava. The right post-cardinal vein in failing to atrophy, as it usually does, forms the main channel from which the inferior vena cava develops. As a result the right ureter is forced to pass behind this vessel. There is nothing characteristic about the patient's complaints.

The authors' patient, a 21-year-old male, had intermittent attacks of right renal colic occasionally associated with the appearance of bloody urine. With time these attacks increased in severity and frequency. Physical examination was negative except for mild costovertebral tenderness on the right. Routine blood and urine studies were essentially normal. On cystoscopy the bladder appeared normal, and catheters could be passed up each ureter without difficulty. Flow from the left kidney was normal, while that from the right was poor. An indigo carmine test showed function to be good on the left and definitely diminished on the right.

complete ankylosis as a part of a general ankylosing spondylitis. Only 2 of the 10 patients with osteoarthritic spondylitis showed any displacement of the bones. In some of the cases the radiologists reported no lesion except arthritic changes: yet there were 8 cases of complete or incomplete paraplegia, with 6 deaths. On 2 occasions at postmortem examination a torn disk and ligaments were discovered, allowing fairly complete abnormal displacement of the bones. These cases are difficult from the radiological point of view, for apart from muscle spasm the neck tends to be stiff and is difficult to examine roentgenographically. The level of the injury may be determined alone by the level of the lesion of the spinal cord, but x-ray evidence of co-existing fracture of an isolated spinous process is helpful.

Two examples of fractures in men suffering from late stages of ankylosing spondylitis occurred. In one case the radiographs revealed a fracture through the ossified intervertebral region between the 3rd and 4th cervical vertebrae without displacement. The second case showed complete ankylosis of the spine from axis to sacrum with a fracture in the region of the 7th cervical with gross anterior displacement on the 1st dorsal. In both cases there was an associated paraplegia with fatal outcome.

MAX CLIMAN, M.D.

Compression Fractures of the Vertebral Bodies and Other Changes Mistaken for Them. John D. Ellis. J. Bone & Joint Surg. 26: 139-145, January 1944.

The most frequent site of compression fracture of a vertebral body is the lower thoracic and upper lumbar region, since it is here that the point of greatest pressure occurs and the interspaces are wider than elsewhere.

In the act of flexion, the first part of the motion occurs through the axis of the nucleus pulposus until its resilience is exhausted; the axis of motion is then shifted to the joints of the arches. This mechanism accounts for the compression affecting the entire superior surface of the body, resulting in a wedge-shaped deformity. The greater deformity of the anterior portion of the body is due to the slight amount of anterior motion permitted at the zygapophyseal joints and to the rolling action of the nucleus pulposus. The inferior surface is less often compressed, probably because of the cupping of this surface, permitting the force to be distributed evenly over the surface by the nucleus pulposus.

The determination of compression is made by drawing parallel lines along the superior and inferior surfaces of the vertebral body. In the normal vertebra these should form an angle of 90 degrees with the posterior surface of the body. In compression fractures, the superior surface is affected alone or to a much greater degree than the inferior surface.

The consensus of opinion seems to be that spondylosis and osteophyte formation in the spine do not result from compression fracture of the vertebrae.

Scheuermann's node is a small triangular portion of bone that appears separated from the antero-superior edge of the vertebral body and is probably due to failure of complete calcification of the cartilaginous end plate. This condition can hardly be confused with fracture. Juvenile osteochondritis of the vertebra or Scheuermann's disease presents a wedging of the vertebral body, but here the superior surface is affected only slightly more than the inferior, the bone

edges are irregular, the surfaces of the adjacent bodies are possibly affected, and the location is most commonly in the lower thoracic region.

JOHN B. McANENY, M.D.

Fractures of the Triquetrum. J. Grant Bonnin and W. P. Greening. Brit. J. Surg. 31: 278-283, January 1944.

Direct injury to the triquetrum is rare owing to its protection by the overhanging end of the ulna. Indirect injury, however, is relatively common, accounting for 3.5 per cent of all wrist injuries. Two forms may be distinguished: (1) injuries by compression and (2) ligament traction or sprain fractures. Oblique views in addition to the anteroposterior and lateral views are necessary for diagnosis. A slightly oblique view throws the shadow of the triquetrum a little above that of the lunate and allows distinction to be made between the two.

Compression injuries take the form of subperiosteal fractures with little displacement, or areas of depression of cortex and lamellae corresponding to the point of maximal pressure. Associated with compression fractures of the triquetrum are posterior marginal fractures of the radius, with a comminuted fracture of the tubercle and fractures of Colles type with anterior dislocation of the lunate and fracture of the pisiform.

The more common ligament traction fractures occur in excessive palmar flexion, the posterior tubercle of the triquetrum being separated by the pull of the ligaments from the body of the bone. Most frequently the fragment is seen lying parallel with the dorsum of the carpus. The small flake of bone frequently remains ununited and can be seen in the lateral view of the wrist, resembling a sesamoid in the extensor tendons. The organized lower surface of the flake enables it to be distinguished from a recent injury. Avulsion of the tubercle is also seen in association with the less common fracture of the posterior pole of the lunate. In these cases radiographs reveal loss of continuity of the line of the lunate and two lines of compact bone in the avulsed fragment. This fracture may readily be confused with fracture of the tubercle of the triquetrum.

MAX CLIMAN, M.D.

Avulsion Fractures of the Fibula. Morris I. Bierman. U. S. Nav. M. Bull. 41: 647-652, May 1943.

The differentiation between a simple sprain of the fibular collateral ligaments and chip fracture of the fibular malleolus is important since the latter is indicative of a complete giving way of the ligament at its point of attachment and, unless adequately treated, may result in instability of the ankle joint.

The usual x-ray technic will not demonstrate an avulsion of the fibulocalcaneal ligament with tearing off of a small fragment of bone. The author, in addition to the usual anteroposterior and lateral views, recommends a third view. The patient lies prone upon the x-ray table and a sandbag is placed under the ankle. A cardboard film holder is inserted between the foot in plantar flexion and the sandbag (if the film holder extends below the toes no increase in pain is felt). The central ray is directed toward the head at an angle slightly greater than 90° with the dorsum of the foot. The anterior margin of the fibula or point of origin of the anterior and medial fasciculus of the fibular collateral ligament is well demonstrated by this

skin distance was uniformly 50 cm. Treatments were usually given every second day. The majority of the cases were treated through one anterior chest field and one posterior chest field. The size of the fields varied. The dose never exceeded 200 r given to each of two, three, four, and occasionally more fields on the same day at the rate of three treatments a week. The tissue dose at the approximate tumor level was 2,500 r in the majority of cases. The predetermined plan of dosage was usually 3,500 r, but treatments frequently were discontinued because of failing health and strength. More than half of the treated cases received in excess of 2,500 r. This experience revealed that the skin and physical tolerance may permit total doses of 8,000 r, 10,000 r, and 12,000 r. Any treatment that exceeded 2,500 r represented the total dosage of two, three, or four series given at six-, eight-, and twelve-week intervals.

In this study the value of irradiation was considered according to the life cycle from the time of instituting roentgen treatment, which was practically always within a few days of making the diagnosis. Of the 119 untreated patients none lived a year after the diagnosis was made; 112, or 94 per cent, lived less than six months. Of the 167 treated patients, 18 lived twelve months or more from the time of making the diagnosis; 2 lived two years; 1 lived three years; 1 lived five years, and 1 is still alive after six years. Eighty-nine per cent lived less than one year; 67 per cent lived less than six months. All of those living two years or more received in excess of 6,000 tissue roentgens. Many patients lived less than one year after total doses of 5,000 to 13,000 r.

The cellular character of the tumor seems to bear little relationship to the response to irradiation. Prognosis was poor in this series of 286 cases of bronchiogenic cancer because of the advanced stage of the disease at which a correct diagnosis was made. Since no patient who was not irradiated survived longer than a year, and since 18 patients who were irradiated lived one to six years, the value of roentgen therapy as a palliative procedure in this disease seems unquestionable. Every patient, therefore, except the few who may be considered operable, should have the benefit of irradiation.

CLARENCE E. WEAVER, M.D.

Three and One-Half Years' Experience with the 1,000 Kilovolt Roentgen Therapy Unit at Memorial Hospital. Alfred F. Hocker and Ruth J. Guttman. *Am. J. Roentgenol.* 51: 83-94, January 1944.

This paper is based on the results obtained in 315 patients with cancer who were treated by a 1,000,000-volt machine. A description of the machine is given. Transformer and tube are contained in a grounded steel tank. The roentgen rays are generated from a target mounted in the end of an extension chamber projecting out from the bottom of the grounded tank. The unit is free from exposed high voltage. It has been made flexible and can be adjusted to the patient. This is especially important when small beams are used, as they are in the higher-voltage unit, because of the relatively larger gain in depth dose. An integrating and recording dosimeter provides a graphic record of each treatment. The following factors are used: a tube current of 3 ma.; a filter consisting of 2 mm. tungsten, 2 mm. mercury, 8 mm. copper, and several mm. of water. These form a half-layer value of 3.8

mm. of lead. The target skin distance is 70 cm. The intensity of the vertical beam is 50 r per minute.

Of 315 patients, 170 were classified as suitable for use as a means of judging the value of the treatment. The treatments were given in daily fractional doses of 250 to 400 r, measured in air. As a rule, they were better tolerated than 200,000-volt treatments by similar patients. Roentgen sickness was not even a problem. With few exceptions the skin reaction from a total dose ranging from 2,100 to 5,000 r per portal was not severe.

Of a total of 315 patients, 213 are dead. In 145 patients palliation was all that could be expected. Some of the 170 suitable cases that remain, if these are eliminated, had already been treated up to the skin tolerance by the 200,000-volt unit and some were so sick that the course of treatments had to be stopped before a satisfactory amount of radiation could be given.

Physical measurements show that at greater depth the higher voltage does deliver a larger dose than is possible with the lower unit. This is particularly true when smaller fields are used. The dose on the surface of exit, however, somewhat offsets the practical value of the greater depth dose. The million-volt unit permits the use of a small field so that less normal tissue is included in the irradiated area.

The present analysis would seem to indicate, however, that the million-volt machine is not a substitute for the 200,000-volt unit; that its use is limited to the treatment of deep-seated tumors. At a depth of 7 or 8 cm., the lower-voltage unit gives nearly as great a dose as the higher-voltage unit, and since the former is a more flexible machine, it is better to use it in the treatment of tumors within that range.

Tables are given showing the survival rate in cancer in various locations of the body after treatment with the million-volt machine.

CLARENCE E. WEAVER, M.D.

NON-NEOPLASTIC DISEASE

Radiation Therapy for Obstructing Tuberculous Hilar Lymph Nodes. Kal Freireich. *Am. Rev. Tuberc.* 49: 31-37, January 1944.

The author reports a case of primary tuberculosis occurring in a seventeen-year-old colored girl who had progressive bronchial obstruction as a result of compression by enlarged tracheobronchial lymph nodes. In spite of general supportive treatment and bed rest, the symptoms became more and more severe, with increasing dyspnea and wheezing. The patient was then given a series of x-ray treatments at weekly intervals, a total of six being given. Each treatment consisted of 112 r at 200 kv., with 0.5-mm. copper filter. Treatments were alternated between the anterior and posterior mediastinum, so that a total of 336 r was given to either side. The symptomatic result was dramatic. After the first treatment was administered, the patient noted diminution in wheezing. Both dyspnea and wheezing had completely disappeared after the third treatment, and the patient was much relieved. No adverse effects on the pulmonary tuberculosis were demonstrated, either symptomatically or on roentgenographic study. It is concluded that radiation therapy for mediastinal tuberculous lymph nodes seems to be a safe procedure when used in consultation with a skilled radiation therapist.

L. W. PAUL, M.D.

EFFECTS OF RADIATION

Clinical Study of the Results of Exposure of Laboratory Personnel to Radar and High Frequency Radio. L. Eugene Daily. U. S. Nav. M. Bull. 41: 1052-1056, July 1943

Observation of 45 civilian employees connected with the experimental radar work at the Naval Research Laboratory convinced the author that there was no clinical evidence of damage to the personnel.

The duration of exposure varied from 2 months to 9 years. Periodic blood counts and physical examinations over a 12-month period were within the normal range. There was no abnormal or premature alopecia, nor were there any unusual dermatologic manifestations. There was no evidence of damage to the reproductive tissues, as judged by the number of conceptions and normal pregnancies during the time of exposure of the fathers to radar.

With the machines operating at peak load there is an area of radio frequency within 3 or 4 feet of a transmitter or antenna. Occasionally a flushed feeling of the face or hands was noted when these were placed directly in the field. A frontal headache sometimes developed after some hours of exposure but disappeared spontaneously in one-half hour to an hour.

ELLWOOD W. GODFREY, M.D.

Abnormal Pulmonary Physiology as a Result of Chronic Irradiation Pleuropulmonitis: John E. Leach. Am. J. Roentgenol. 50: 772-778, December 1943.

Seventeen patients with different degrees of chronic irradiation fibrosis of the lung were subjected to various tests of pulmonary and circulatory function. Comparison of the results with those obtained from a group of normal persons and patients with other pulmonary disorders, as emphysema, pneumothorax, etc., indicates that chronic irradiation pleuropulmonitis is really a disturbance of the entire thorax, resulting in fixation of a portion of the thoracic parietal structures, fibrosis of the pleura and lung parenchyma due to irradiation, a secondary alveolar fibrosis beyond the irradiated area, mediastinal fibrosis with partial fixation of the lung hilum, structural changes in the wall and mucosa of the large bronchi, partial immobilization of the diaphragm, and some degree of compensatory emphysema of the untreated side.

The most disabling feature is the severe dyspnea that may follow ordinary exercise. Many of these patients are obese and this alone induces greater ventilation reflexly and reduces the maximum ventilation capacity mechanically. Additionally, the relationship between the ventilation per minute and the maximum ventilatory capacity is markedly changed in the presence of irradiation pleuropulmonitis. L. W. PAUL, M.D.

EXPERIMENTAL STUDIES

Absorption of Radioactive Sodium Instilled into the Vagina. W. T. Pommerenke and P. F. Hahn. Am. J. Obst. & Gynec. 46: 853-855, December 1943.

In a study of the absorptive properties of the vaginal tissues, the authors used a solution containing radioactive sodium. This was introduced into the vaginas of 7 women and observations were made in normal subjects, following subtotal hysterectomy, post partum, and in one patient with threatened abortion. The amount of salt instilled ranged from 105 to 150 mg., about 10 c.c. of solution being used in each instance. Blood samples taken at different intervals thereafter were examined with the aid of a Geiger-Müller counter for radioactivity.

Wide fluctuations were observed in the amounts of sodium absorbed—from 0.2 after an interval of thirty minutes in a normal subject to 11.5 after eighteen hours in a patient twelve days post partum. No parallelism was noted between the amount instilled and that recovered from the blood. The greatest percentage of absorption occurred in women who had recently been delivered or whose vaginas and cervixes had been variously traumatized. It thus appears that the clinical condition of the vaginal wall and/or cervix may be the important determining factor which controls the amount of absorption.

These experiments suggest the need for special caution in administering douches containing poisonous ingredients, particularly when the vagina and/or cervix have been recently traumatized.

STEPHEN N. TAGER, M.D.

Influence of Irradiation-Killed Cells on Tumor Growth. Paul S. Henshaw. J. Nat. Cancer Inst. 4: 305-307, December 1943.

Although it seems certain that the direct action of irradiation destroys tumor tissue, it is probable, also,

that indirect effects of irradiation play a role in tumor regression, since (1) tumor cells *in vitro* are more resistant to irradiation than those *in vivo*, (2) tumor cells transplanted to an irradiated area are less likely to grow than when transplanted to a non-irradiated area, and (3) irradiated tumor cells undergoing regression will grow and kill the host if transplanted to a new area. Three possible types of indirect action may be: (1) damage to the local vascular system altering tumor metabolism; (2) changes in the stroma and malignant cells followed by leukocytic infiltration, fibrosis, and encapsulation; (3) production of toxic tissue products (necrotoxins) from destroyed cells.

Three experiments were carried out to test the last named hypothesis of necrotoxic effect. Macerated tumor tissue (mouse sarcoma 37) was given a lethal dose of 5,000 r in 25 minutes. This was then mixed with unirradiated tumor pulp in the proportions of 25 to 75 per cent, 50 to 50 per cent, and 75 to 25 per cent, and injected in mice, 10 animals being used for each mixture. Rapidly growing tumors were obtained in all the animals. In a second experiment the irradiated tumor pulp was injected subcutaneously around growing tumors in such a manner that the tumor was surrounded by a ring of dead tumor pulp three to four times its size. No retarding effect was observed. In the third experiment, tumors *in vivo*, 10 to 15 mm. in diameter, were subjected to a dose of 5,000 r, the remainder of the host being effectively shielded. Viable tumor tissue was then injected into the treated site. The usual slough with ulceration occurred in the expected time but the tumor invariably recurred.

It may be concluded, therefore, that so far as the material tested is concerned, irradiation-killed cells or their decomposition products exert no inhibitory influence on the growth potentiality of viable tumor cells.

LESTER M. J. FREEDMAN, M.D.

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Adenoma of the Bronchus: A Clinical and Roentgenologic Study with a Report of Seven Cases¹

THOMAS LOWRY, M.D., and LEO G. RIGLER, M.D.

University of Minnesota, Minneapolis, Minn.

THE LARGE majority of primary bronchial neoplasms are malignant. The internist and the roentgenologist are encountering cases of bronchiogenic carcinoma with ever increasing frequency, and indeed it is now recognized that this tumor is among the commonest of malignant growths, occurring more often in autopsy series than any type except gastric cancer. It is also interesting to note that carcinoma of the bronchus has in the past twenty-five or thirty years increased in incidence to a considerably greater extent than can be accounted for by the advance of the average life expectancy.

More significant for the clinician than the increasing occurrence of bronchial tumors, however, is the fact that during the past twenty years rapid progress has been made in the development of more accurate diagnostic means of identifying the condition in its early stages. Moreover, the recent strides of the thoracic surgeons have made it possible in suitable cases to treat cancer of the bronchus by removal of an entire lung, and it has now been clearly and repeatedly demonstrated that at least a few of these lesions may be

cured by prompt radical surgery if the diagnosis is established sufficiently early. Thus, with improvement of both diagnosis and the methods of attack, bronchiogenic neoplasms are no longer of solely pathological interest but also constitute a challenge to the ingenuity of the clinician.

Benign bronchial tumors, though much less common than the carcinomata, are by no means rare. Several types have been described, including adenoma, chondroma, fibroma, lipoma, and a few other unusual varieties. The so-called bronchial adenoma accounts for about 80 per cent of the group of benign growths and is therefore by far its most important member. This condition has been the subject of many controversies regarding its histologic origin, its potential malignancy and relationship to carcinoma of the bronchus, and its proper treatment. We shall maintain in this discussion that, regardless of pathologic terminology, the disease which has been generally known as "bronchial adenoma" fits into a fairly definite clinical pattern and that its prognosis is quite different from that of cancer. We believe, therefore, that it is of importance to attempt a distinction between these neoplasms and that only in the light of such a distinction can the risks of the various possible therapeutic measures be properly weighed at the present time.

¹ From the Departments of Medicine and of Radiology and Physical Therapy of the University of Minnesota. Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

TABLE I: MECHANICAL EFFECTS OF BRONCHIAL TUMORS

Stage	Effect on Bronchus	Manifestation
Early	No obstruction Irritation of mucosa Erosion of mucosa	None Cough Hemoptysis
Moderately advanced	Partial obstruction	Dyspnea Wheeze — often localized. Impaired bronchial drainage resulting in fever, pneumonitis, purulent sputum, and eventually bronchiectasis
Far advanced	Obstruction, partial in inspiration, but total in expiration Total obstruction	Obstructive emphysema Total atelectasis, usually with suppuration

considerable risk. His decision, in some instances, may depend upon the relative magnitude of the risk incurred by consenting to something less than radical surgical removal. Since the chance of death from malignant metastasis in bronchial adenoma is so slight, the tumor should, with this small reservation, be regarded as clinically benign when it is necessary to balance the risk of a therapeutic procedure against the mortality of the disease.

CLINICAL FEATURES

Although adenoma of the bronchus almost always remains benign as far as lethal metastasis is concerned, its effects upon the lung are extremely serious and in many instances ultimately cause death. The tumor grows slowly and gradually occludes the bronchus in which it arises. During this process repeated infections occur distal to the obstruction, and sooner or later the portion of lung involved is destroyed by recurring suppuration. Bronchiectasis is regularly produced, and more acute infectious processes such as suppurative pneumonia, pulmonary abscess, and empyema may occur and eventually prove fatal.

In the recognition of bronchial adenoma, the clinical history commonly provides valuable clues. Usually there have been episodes of pneumonia characterized by cough, purulent sputum, fever, and frequently pleural pain. These attacks of pulmonary infection are often severe and slow to resolve. They recur repeatedly

in the same part of the lung. Between the bouts of acute inflammation, there are intervals of good health in most instances, during which, however, a cough may persist. (This occurrence of healthy intervals is in contrast to the usual clinical course of carcinoma, which progresses without remission.) Hemoptysis is a prominent symptom of adenoma, occurring at some time in two-thirds of the cases. Not infrequently bleeding is relatively profuse and may be repeated. The hemorrhage tends to start and stop abruptly and, even more than other types of hemoptysis, is apt in women to accompany the menses. As has been stated, cough is generally present once the neoplasm is well established, and this may or may not be productive, depending upon the degree of pneumonitis or bronchiectasis present. Wheezing, due to partial obstruction of the bronchus, is often a complaint, and the rhonchus may be localized by the patient or the examiner in one lung or even in a certain lobe. In advanced cases with marked bronchial obstruction dyspnea and cyanosis occur.

The physical signs of adenoma of the bronchus vary tremendously; they depend entirely upon the degree of bronchial occlusion and upon the type and extent of secondary changes which have been produced in the lung. The commonly encountered conditions are summarized in Table I. An early lesion may give no abnormal signs or may cause a coarse rhonchus distal to the tumor. Later, dullness,

râles, and diminished or tubular breath sounds may signify the presence of pneumonitis. In the late stages the signs are those of total atelectasis. A few cases at some stage show obstructive emphysema and in practically all there is some degree of bronchiectasis within a year or two after the onset of symptoms.

ROENTGENOLOGIC FEATURES

As might be expected from the nature of the process, the roentgen findings in adenoma of the bronchus are of the first importance in the recognition of the condition. While it is true that cases have been reported in which the tumor was so small that it did not interfere appreciably with the aeration of the lung and hence produced no x-ray findings whatever, such a situation must be exceedingly rare and was not encountered in our experience.

Roentgen examination presents two types of evidence with regard to benign bronchial tumors. The first, which was the only evidence available until recently, relates largely to the secondary effects of the obstruction. Thus atelectasis (Figs. 1a, 9), commonly accompanied by the "drowned lung" phenomenon (Fig. 3a), is a frequent finding; especially characteristic is its tendency to be intermittent and recurrent. The atelectasis may be band-like, producing linear areas of increased density with some general decrease in the radiability of the lung. More commonly it is lobar in type, with a whole lobe collapsed down into a paravertebral triangle of increased density, while the remainder of the lung on that side exhibits greater radiability than normal owing to the expansion of the uninvolved lobes. Secondly, the presence of pneumonitis (Figs. 5, 9), which is likewise remittent and recurrent, is suggestive. In this case, rather than the sharply demarcated dense shadow of an atelectatic lobe, there is an irregularly distributed non-homogeneous density in the area of involvement suggesting somewhat the appearance of an atypical pneumonia. Finally, the demonstration in simple roentgenograms (Figs. 4a,

5), or by means of bronchography (Figs. 1b, 4b), of bronchiectasis localized to one lobe should always suggest the possibility of a bronchial adenoma. The demonstration of a mediastinal mass (Fig. 8) resembling a tumor, with associated evidences of bronchial obstruction, should likewise lead to further investigation because of the possibility of an extrabronchial extension of such a tumor.

The addition of bronchography with iodized oil makes it possible to demonstrate with reasonable accuracy the presence of the associated bronchiectasis (Figs. 1b, 4b) and the location of the obstruction (Fig. 1b). The delineation of the typical "cap-shaped" defect in the bronchus (Fig. 1b) is frequently possible and lends added weight to the diagnosis. This type of defect is due to the layering of the iodized oil over the round, rather smooth tumor and is in sharp contrast to the more diffuse elongated "rat-tail" type of obstruction found in carcinoma of the bronchus.

Finally the use of body section roentgenography, during the past five years, has permitted the direct visualization of the tumor itself as a rounded, sharply defined, dense shadow seen in contrast to the air in the bronchus which surrounds it (Figs. 2a, 3b, 3c, 6, 8, 10). Unfortunately, it is not always possible to make this demonstration satisfactorily. When it is possible, however, it is of the first importance in the diagnosis of the condition. In some instances the tumor has been demonstrated more effectively in the body section roentgenograms than it has in the bronchograms made with iodized oil.

It goes without saying that the roentgen findings are partially inferential, partially suggestive, only rarely conclusive in the diagnosis of bronchial adenoma. The final diagnosis must be made with the aid of the bronchoscope and the microscopic examination of a biopsy specimen, but the detection of this lesion depends so much upon its consideration in any case of chronic lung disease that the suggestive findings obtained on roentgen examination

TABLE II: DIFFERENTIAL DIAGNOSIS OF BRONCHIAL NEOPLASMS

	Adenoma	Carcinoma
Age	80 per cent under 40	90 per cent over 40
Sex	70 per cent females	85 per cent males
Bronchoscopic appearance	Smooth, pink, oval or lobulated; often pedunculated. Bronchus not fixed. Troublesome bleeding on biopsy	Irregular, yellowish or gray; often ulcerated. Bronchus infiltrated and fixed. Bleed readily but not profusely
Clinical findings	Attacks of suppuration; intermittent with long healthy intervals	Suppuration or atelectasis, usually progressive. Steady downhill course
Bronchiectasis	Frequent, due to chronicity of course	Infrequent; course usually too rapidly progressive
Type of hemoptysis	Often profuse, with sudden onset and abrupt cessation	Usually only streaking, which is often continuous

are of the first importance in leading to further study. When there is added to the secondary findings described above the demonstration of a typical "cap-shaped" defect in the bronchograms or the positive shadow of a round, sharply defined mass within the lumen of the bronchus in the planigrams, the roentgen diagnosis of bronchial adenoma is highly reliable. In such instances, if bronchoscopy is unsuccessful or impossible, the roentgen evidence is the most conclusive obtainable.

In the follow-up study of such patients to determine the effects of conservative therapy or to decide on more radical measures, repeated x-ray examinations, particularly with planigraphy, have been of inestimable value to us. In this manner we have been enabled to follow the size both of the intra- and extrabronchial mass (Figs. 2, 8), to determine the effects of hemorrhage after bronchoscopic procedures (Figs. 2b, 8b), and to establish conclusively the improvement in the secondary lung changes which follows relief of the obstruction (Figs. 2d and 4a).

The roentgenographic findings and their value are well illustrated in the accompanying case reports.

BRONCHOSCOPY

The final diagnosis of adenoma of the bronchus is ordinarily made by the bronchoscopist. When the mass is visualized, its gross features (previously described) and absence of the infiltration and fixation of the bronchial wall so common in

carcinoma are extremely important in arriving at a correct conclusion regarding the nature of the tumor. Biopsy or other instrumentation generally causes free bleeding. This may be profuse, and very often a portion or all of the bronchial tree on the involved side may be occluded by blood clot. In our experience this clot is best left to liquefy and be removed by natural processes; ordinarily it clears out within a few days. Attempts at bronchoscopic removal of the clot are often followed by further hemorrhage.

Pathologic identification of these neoplasms by microscopic examination of a small biopsy section may be difficult or impossible. In some instances no tumor cells, but only overlying epithelium and stroma are obtained. In others, the lack of differentiation of the cells leads to an erroneous diagnosis of carcinoma. It has therefore come to be our opinion that a diagnosis of adenoma of the bronchus must rest upon the total clinical picture including history, roentgen studies, and gross bronchoscopic findings. If all these features are in accord and indicate adenoma, a conflicting biopsy report should not be accepted as proof of cancer.

DIFFERENTIAL DIAGNOSIS

In most instances of bronchial adenoma, the diagnosis can be rather easily made with the methods now available, once the possibility of this condition is considered. The tumor occurs only in the larger bronchi and can usually be seen through the

bronchoscope. By the use of this method, supplemented by roentgenograms made with the technic mentioned above, the lesion can almost always be identified. The clinical features which we consider important, in addition to the roentgen findings, in distinguishing adenoma from carcinoma of the bronchus have been discussed and are summarized in Table II.

Bronchial adenoma may be confused, also, with chronic pulmonary tuberculosis, simple bronchiectasis, and inflammatory granuloma of the bronchus. The basis of such confusion is clear. All these conditions are characterized by chronic pulmonary infection with productive cough and varying degrees of fever. All of them regularly cause hemoptysis. Diagnostic errors will usually be avoided, however, if the clinician has bronchial adenoma in mind as a possibility. The patient with a chronic productive cough, recurrent hemoptysis, and a fibrocavernous destruction of one upper lobe, whose sputum is invariably negative for tubercle bacilli by all methods, must not be assumed to have pulmonary tuberculosis, but should be investigated by planigram, bronchogram, and bronchoscopy. The same applies to any case showing recurrent atelectasis or pneumonia in one portion of the lung, whether or not bronchiectasis is present in the involved area. The differentiation of inflammatory granuloma from adenoma of the bronchus may be possible only by microscopic examination of an adequate biopsy section for the presence of tumor cells. In general it may be stated that adequate diagnostic tools are at hand for the differentiation of these conditions provided the physician has in mind the possibilities.

TREATMENT

Adenoma of the bronchus has been treated by three general methods:

(1) *Bronchoscopic removal* by mechanical or electrosurgical means is helpful in many circumstances and remains the method of choice in certain cases. We believe that a young patient with an early ade-

noma, whose lung shows little evidence of damage and who can be closely followed, should have a trial of local removal, since in a considerable number of cases these tumors have not recurred during periods of observation up to twelve years. Particularly do we favor this course when the lesion involves the main bronchus so that pneumonectomy would be required for radical removal. In the patients who refuse pulmonary resection, and in a few whose tumor is so located as to forbid it (*e.g.*, Case 4), local removal and follow-up by planigraphy and bronchoscopy at intervals constitute the method of second choice. Marked symptomatic improvement will result in many instances. Also, all patients who are to undergo lobectomy or pneumonectomy should have preliminary local removal of the adenoma to permit optimum preoperative drainage of suppurative areas in the lung so as to minimize the surgical risk.

(2) *Irradiation*: X-ray therapy and the application of radon have been given but a limited trial. Most authors have had only a small experience with the method and feel that it is of slight value. Foster-Carter has found irradiation efficacious but reports two or three deaths from hemorrhage after treatment by this method, apparently because deep necrosis in the bronchial wall has eroded large vessels. The method probably deserves further investigation with carefully controlled dosage, for those who have used it most find bronchial adenomata to be somewhat radiosensitive.

(3) *Pulmonary Resection*: Most authors now feel that the majority of cases of adenoma of the bronchus, because of the high incidence of local recurrence and extra-bronchial extension, will sooner or later require pulmonary resection. A recent article stated that this was the method of choice in 90 per cent of instances. This figure is perhaps too high, but it conveys the present trend of opinion among those interested in this subject. Clearly, total removal will give the most desirable end-result in treatment of a neoplasm which

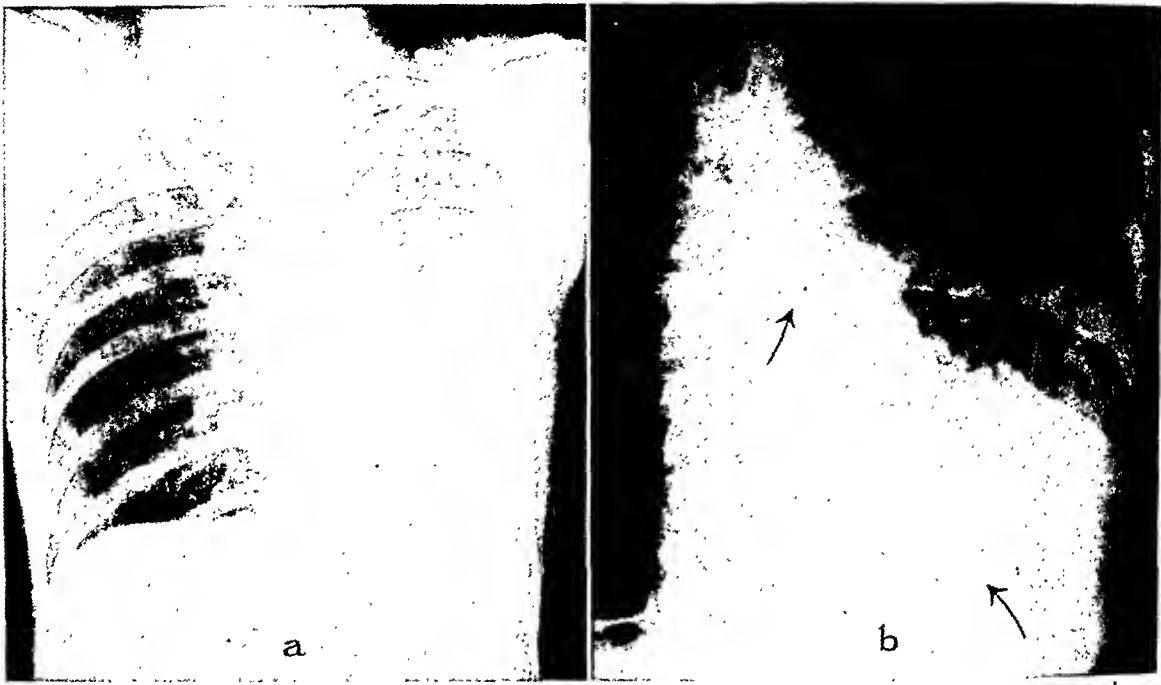


Fig. 1. Case 1. Bronchial adenoma, left lower lobe.

- a. Postero-anterior roentgenogram exhibiting atelectasis of left lower lobe. Note mottled density, displaced heart, elevated diaphragm.
- b. Bronchogram exhibiting typical "cap" deformity of bronchial adenoma (upper arrow) and bronchiectasis (lower arrow).

may recur, may produce serious pulmonary damage, and has occasionally been known to give rise to a malignant growth. There is no argument about this fact; the only disturbing feature is the risk assumed in the curative procedure. In some instances, the choice of a plan of management is simple and obvious, but in others this may be a difficult question to decide. We believe that after a thorough diagnostic study has been made, each case must be carefully and individually assessed with respect to the amount of pulmonary damage, location of the tumor, and size of extrabronchial extension if one is present. On the basis of these features it should be possible to form a rough idea of the patient's prognosis if the neoplasm is *not* radically removed. Against this prognosis must be weighed the risk of whatever operative procedure is thought necessary to accomplish extirpation of the lesion. If the choice of radical surgery is in doubt, the patient and his family must be consulted, since either alternative may be somewhat hazardous, and the patient him-

self should have a voice in the decision.

The general policy which we follow at present in attempting to balance the risks in these cases is as follows. If the adenoma is so located that it can be removed by a lobectomy or by combined resection of the middle and lower lobes, we advise that this be done, except for the few patients selected for local removal, as previously described. The surgical risk of lobectomy is now so low (well under 5 per cent in most clinics) that this procedure gives the patient his best chance regardless of the type, location, etc., of the tumor. If pneumonectomy is required, the problem is complicated by the considerably higher mortality of the operation (hardly under 15 to 20 per cent for this type of case except perhaps in the hands of a very few men). In these cases, in general, we prefer to carry out local removal *via* the bronchoscope and observe the patient for a year or two. If the tumor recurs rapidly or if troublesome symptoms persist due to pulmonary suppuration, pneumonectomy is recommended as

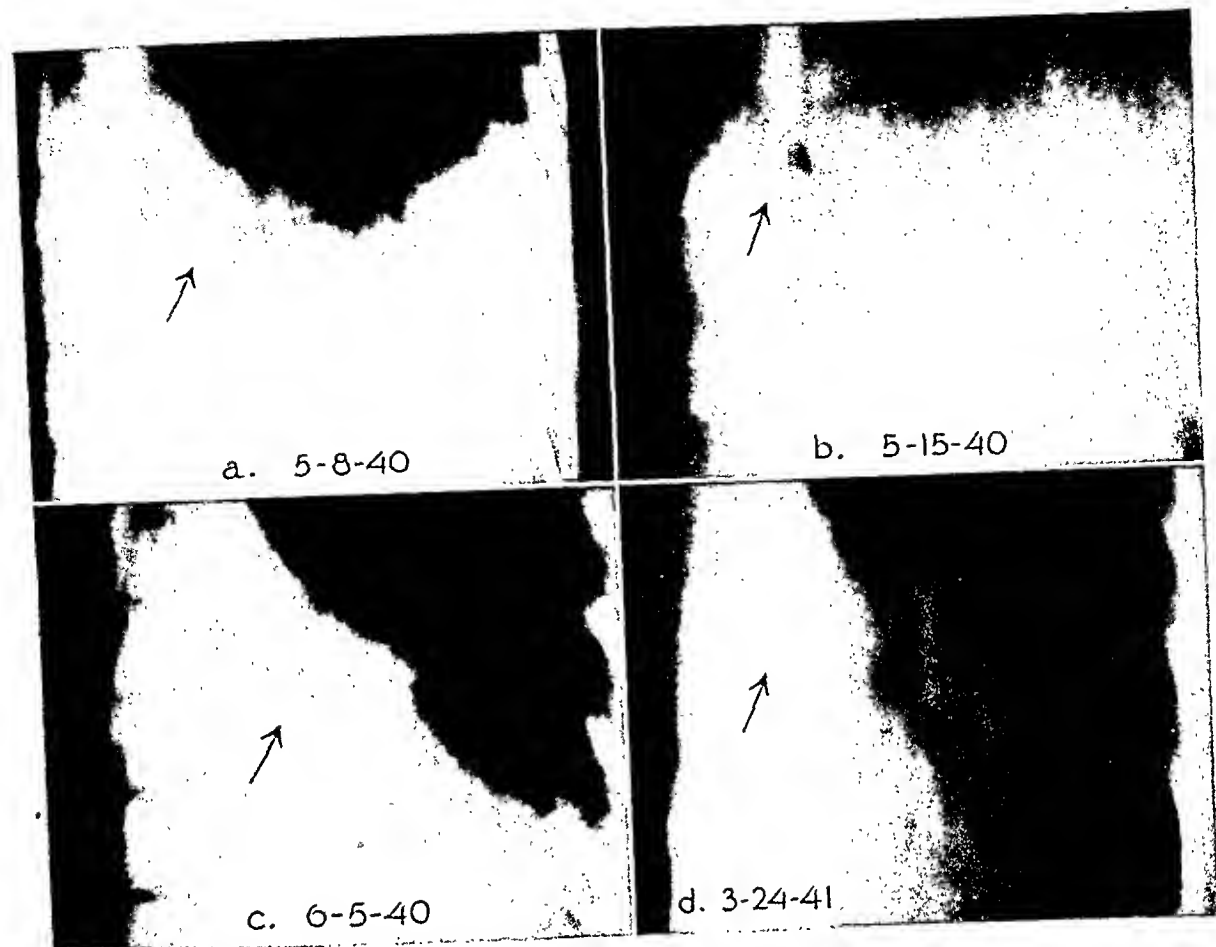


Fig. 2. Case 1. Body section roentgenograms.

- a. First planigraphic study exhibiting sharply defined, rounded tumor (arrow) in left main bronchus. Note air column extending into upper lobe bronchus partly obstructed and complete obstruction of lower lobe.
- b. Body section roentgenogram after first bronchoscopy with resultant hemorrhage. Note complete obstruction of air column (arrow) in left main bronchus, due to accumulation of blood, and increased density of entire left lung.
- c. Re-examination after hemorrhage had cleared up, showing reduced size of tumor (arrow) and increased aeration of lung.
- d. Final body section roentgenogram after adenoma had been removed by local excision. Note clear airway in left main bronchus (arrow) without any sign of tumor and almost fully aerated lung field.

less dangerous than permitting the patient to go without radical resection. If, on the other hand, the symptoms disappear with removal of obstruction to the bronchus, and the adenoma does not recur, the patient is simply watched by means of body-section roentgenograms and bronchoscopic examinations at regular intervals. The presence of a large extrabronchial extension of the growth, especially if it shows evidence of increasing in size, may influence the decision in favor of resection.

CASE REPORTS

CASE 1: A female, 29 years of age, was admitted May 20, 1940, with a history of pneumonia in the

left lower lobe, fever, loss of weight, and a small hemoptysis. She had had a cough in February 1940 with fever and was sent to the Minnesota State Sanatorium, where she was given sulfonamide therapy and released seventeen days later, feeling well. Several weeks later the cough recurred. There was loss of appetite, and the patient was again admitted to the Sanatorium because tuberculosis was suspected. There an atelectasis of the left lower lobe was discovered and she was sent to the University Hospital for further study. One week prior to admission there had been a small hemoptysis. There was no history suggesting aspiration of a foreign body.

On examination the patient appeared acutely ill, with a fever of 101.6° , pulse 140, respirations 24. There was evidence of obstruction of the left main bronchus, with dullness, diminished expansion, and diminished breath sounds over the whole left lung.

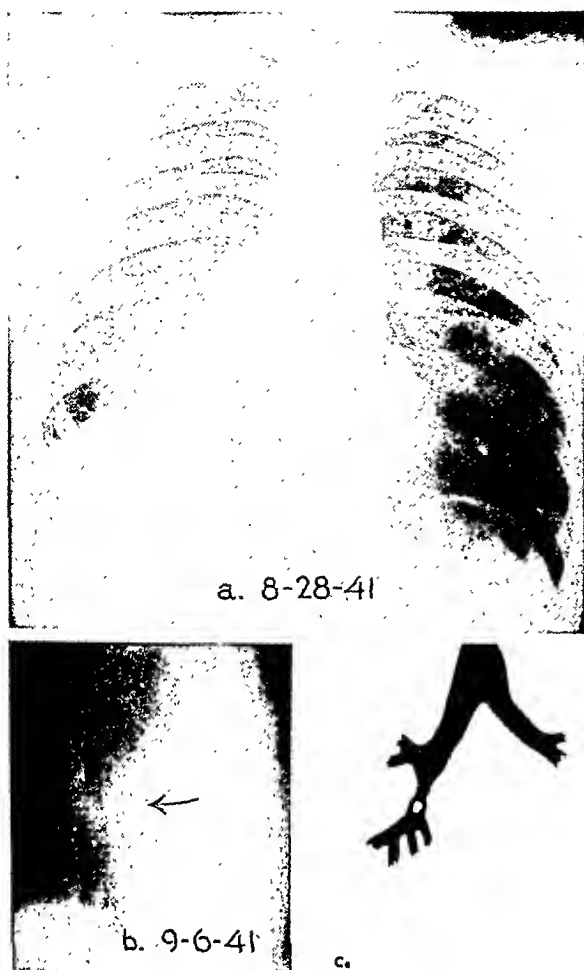


Fig. 3. Case 2. Bronchial adenoma, right lower lobe.

a. Postero-anterior roentgenogram showing typical "drowned lung" and atelectasis of right lower lobe and compensatory emphysema of right middle lobe.

b. Body section roentgenogram showing small, round, sharply defined tumor (arrow) within air column of right lower lobe bronchus.

c. Diagrammatic representation of bronchi and tumor as shown in b.

The mediastinum was displaced to the left. The significant laboratory finding was leukocytosis of 23,000 with 88 per cent polymorphonuclears. The diagnosis was obstruction of the left bronchus with atelectasis and infection of the distal lung.

Roentgen examination (Fig. 1a) revealed atelectasis and some "drowned lung" effect in the left lower lobe. The diaphragm was elevated and the heart was displaced to the left. The appearance was characteristic of bronchial obstruction. Bronchography (Fig. 1b) revealed a constriction of the left lower lobe bronchus with a fairly large cap-shaped filling defect, characteristic of adenoma. Distal to it a typical saccular bronchiectasis was shown.

Body section roentgenography was then undertaken (Fig. 2a). A sharply defined rounded shadow could be made out within the lumen of the left main bronchus just proximal to its bifurcation. This ap-

peared to obstruct the lower lobe almost completely, the upper lobe only partially.

Bronchoscopy was done by Dr. Logan Leven, and the tumor was visualized as a smooth, round, pink mass in the left main bronchus. Following gentle instrumentation it bled freely and seemed to disappear from view, so that no tissue could be obtained. Following the procedure, the entire left bronchial tree became occluded by blood clot, and a "drowned lung" resulted (Fig. 2b). The patient became very ill, with temperature of 105°. Bronchoscopy was repeated for removal of the clot, but this only started fresh bleeding and the attempt was abandoned. As the clot absorbed, the patient improved gradually and the lung cleared. She left the hospital about five weeks after admission. At that time, the tumor was much smaller and the obstruction correspondingly relieved (Fig. 2c).

The patient gained weight rapidly after leaving the hospital and had very little cough. Only occasionally was there a small amount of purulent sputum. The only symptom was dyspnea on moderate exertion. She was followed in the Out-Patient Department until February 1941. The situation did not change appreciably. It was felt that the tumor should be removed if possible before it grew sufficiently to occlude the bronchus again. Accordingly, the patient was readmitted, and at this time the bronchial mass was removed through the bronchoscope by Dr. Leven. Only slight bleeding and no untoward reaction occurred.

Planigraphy was again undertaken (Fig. 2d). The clear airway in the left main bronchus is in sharp contrast to the examinations made on the previous occasions (Fig. 2).

In this patient there is undoubtedly much permanent lung damage in the form of bronchiectasis and fibrosis. At present râles are audible throughout her left lung. Further observation will be necessary to decide whether radical surgery will be required to manage this residual bronchiectasis. At present, however, she has no cough and very little sputum and has gone through two winters without difficulty. Therefore, the symptoms hardly justify a pneumonectomy at this time.

Comment: The brilliant delineation of this tumor and the recording of its gradual disappearance, as well as the filling up of the bronchus with blood, by the body section roentgenograms are notable. The apparently good results from local treatment are also to be observed.

CASE 2: A 32-year-old white male was admitted in August 1941. He had had pneumonia four times between the ages of ten and thirty-one. For one year a cough had been present, productive of one cupful daily of purulent sputum, which was sometimes blood-streaked and slightly fetid. The patient was well developed and well nourished. There was re-

duced expansion of the right hemithorax. On percussion, dullness was elicited over the lower half of the right lung posteriorly, with diminished breath sounds, a few coarse râles, and a transient expiratory wheeze in this area. Examination was otherwise normal. The laboratory findings were within normal limits. The sputum was foul, but bacteria were not found.

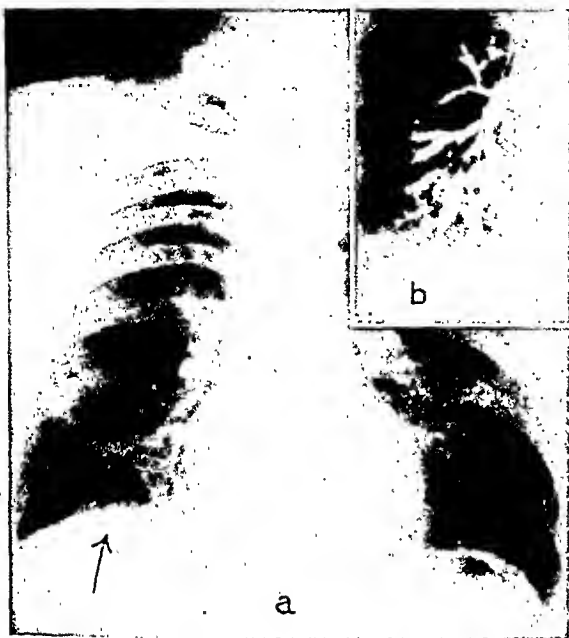


Fig. 4. Case 2. Bronchial adenoma of right lower lobe.
a. Postero-anterior roentgenogram after local removal of tumor, showing bronchiectasis (arrow).
b. Bronchogram of right lower lobe exhibiting dilatation of bronchi resulting from tumorous obstruction.

X-ray examination of the chest (Fig. 3a) showed consolidation in the right lower lobe with some evidence of atelectasis and drowned lung. The appearance suggested bronchial obstruction such as occurs from a tumor. Planigraphy was then done (Figs. 3b, 3c) and showed a rounded, sharply defined shadow in the right lower lobe bronchus characteristic of adenoma.

Bronchoscopy revealed a smooth, rounded, pink mass obstructing the right lower lobe bronchus, which bled easily and proved to be an adenoma. It was removed locally, but subsequent bronchography showed extensive bronchiectasis in the previously obstructed area.

The patient's symptoms disappeared in one month. He has been seen periodically since and his cough has not recurred. A check-up bronchoscopy in April 1942, eight months after removal of the growth, showed no recurrence, and a lipiodol study done over a year after the procedure showed the bronchus to be unobstructed. Ordinary roentgenograms of the lung (Fig. 4a) showed evidences of bronchiectasis, and persistent râles in the right lower

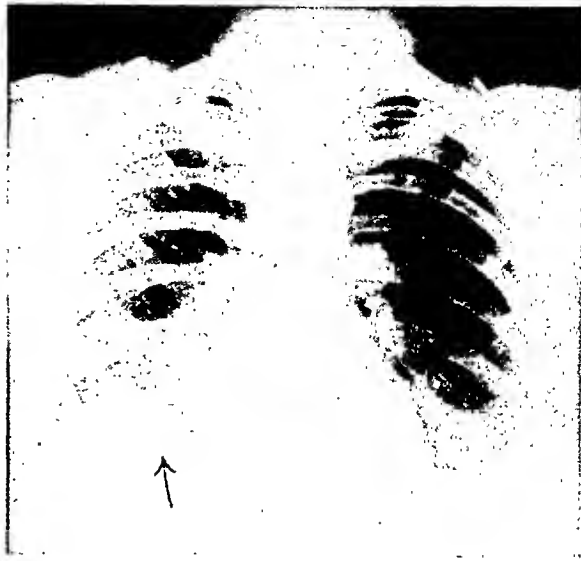


Fig. 5. Case 3. Bronchial adenoma, right lower lobe. Postero-anterior roentgenogram showing typical "honey-comb" lung of bronchiectasis. The presence of bronchiectasis confined to one lobe is suggestive of bronchial adenoma.

lobe testify to the presence of the bronchiectasis shown by bronchography (Fig. 4b). The patient's improvement was so striking that the surgical staff decided to defer the lobectomy, which had been planned to follow bronchoscopic extirpation of the adenoma.

Comment: In this case, also, the tumor was seen directly by planigraphy and the finding confirmed on bronchoscopy. The apparent good result following local removal through the bronchoscope is notable.

CASE 3: A female aged 26 presented herself on May 21, 1943, with a history of having had a cough since November 1942. She thought she had had an attack of pneumonia, with chills, fever, and pain over the right lung. She was in bed for twenty-six days, twelve of which were spent in a hospital. For some time after discharge from the hospital the temperature and pain continued. With the cough there was sputum, which was yellow. Later she coughed up dark blood. She was pregnant at the time. On April 10, 1943, she had another attack of what was thought to be pneumonia, having a chill, fever, perspiration, and prostration. She was taken to the hospital, where she apparently got better. Her baby was born May 10.

On entrance the patient was still coughing. The cough was productive and the sputum contained considerable amounts of blood. She thought she was a little hoarser than normal at that time. The physical findings showed some limitation of motion on the right. The breath sounds were diminished

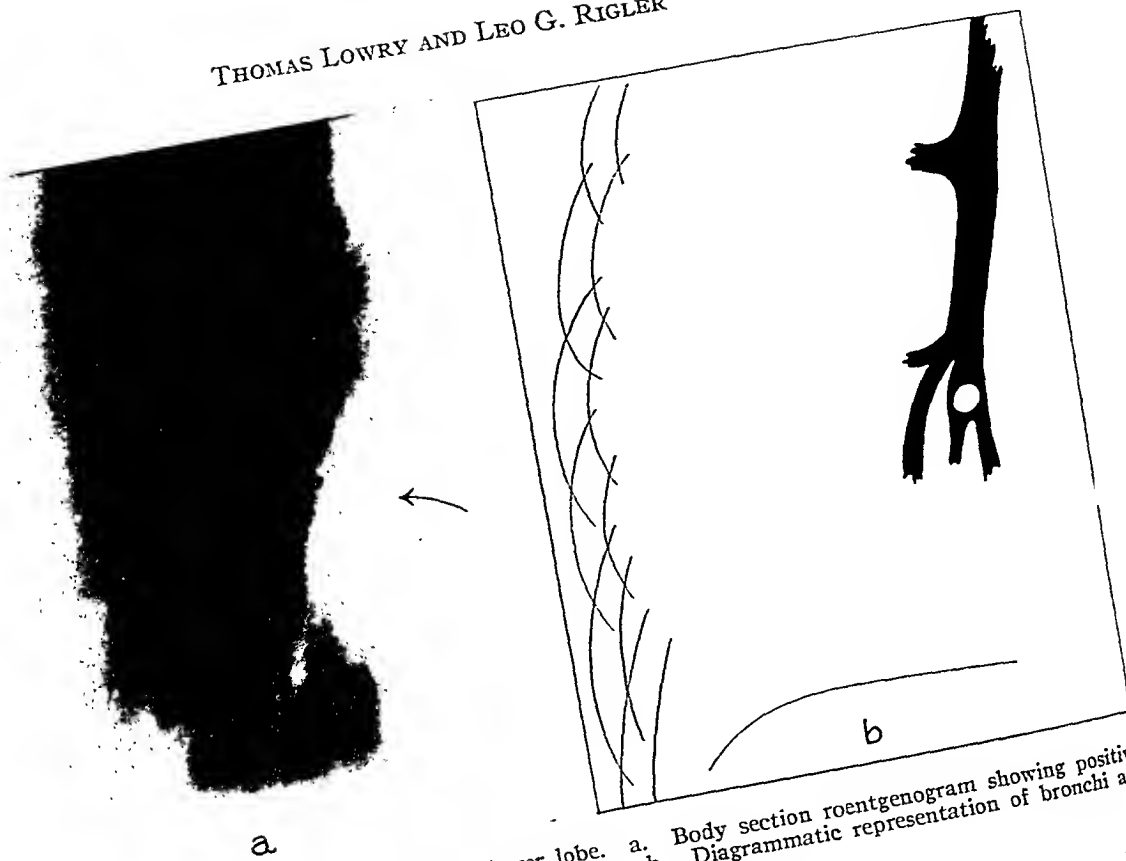


Fig. 6. Case 3. Bronchial adenoma, right lower lobe. a. Body section roentgenogram showing positive shadow of adenoma (arrow) in right lower lobe bronchus. b. Diagrammatic representation of bronchi and tumor as shown in a.

over the right lower lobe, and râles were heard here also. The first impression was an unresolved pneumonia.

The first roentgen examination of the chest (Fig. 5) showed an area of increased density in the right lower lobe with areas of rarefaction within it. The appearance suggested bronchiectasis with probably some type of pneumonitis. These findings were observed during routine fluoroscopy.

After physical examination by one of us (T. L.), the possibility of a bronchial adenoma was suggested. Body section roentgenography was carried out, and the bronchiectatic cavities were well seen. In the lumen of the right lower lobe bronchus a rounded, fairly well defined mass could be seen, which was quite suggestive of bronchial adenoma (Fig. 6).

Bronchoscopy was first done June 4. A smooth, globular, red mass was seen filling the lumen of the right main bronchus just at the point of division between the middle and lower lobes. Tissue was removed for biopsy and showed irregular cords and clusters of deep-staining cells, suggesting carcinoma but more likely bronchial adenoma.

Because of the questionable malignancy of the lesion, exploratory thoracotomy was advised. Surgery was undertaken on June 26, 1943, by Dr. O. H. Wangenstein, and the right middle and lower lobes were resected.

In the specimen a rounded tumor, slightly over 1 cm. in diameter, was found, just at the bifurcation of the right lower lobe bronchus, which seemed to

occlude both the middle and lower lobes. The bronchi were markedly dilated distally, and there was a distinct bronchiectasis within the lung itself. The section of the tumor was exactly similar to that found on biopsy, adenoma of the bronchus being indicated. A section of a lymph node removed from the site of the lesion showed no evidence of disease. Convalescence was somewhat stormy, but the patient recovered with a moderate expansion of the remaining lobe. There is some residual fistula.

Comment: The typical history of repeated attacks of pneumonia together with persistent hemoptysis and physical evidence of bronchial obstruction led to the diagnosis in this instance. The roentgen examination revealing a localized bronchiectasis in one lobe is suggestive. Body section roentgenography gave positive evidence of the tumor, while the bronchoscopy and biopsy confirmed the diagnosis. The excellent results from lobectomy are notable, although insufficient time has elapsed to determine their permanency.

CASE 4: A 39-year-old female complained of cough, dyspnea, a sense of pressure over the right chest, and repeated hemoptysis of approximately

thirteen years' duration. When blood was first noticed in the sputum, x-ray examination had been made, and she was told there was "a spot on her lung." The hemoptysis seemed to have some relationship to her menstrual periods. There was no loss of weight.

The essential physical findings were some respiratory lag of the right chest and some diminution of breath sounds over the same area. The breath sounds were harsh, with an inspiratory thrill suggestive of bronchial obstruction.

The first roentgen examination was made on April 28, 1942, and revealed a mass in the right superior portion of the anterior mediastinum (Fig. 7). Body section roentgenography was carried out later (Fig. 8a) and demonstrated a mass protruding into the lumen of the right main bronchus and merging with the extrabronchial mass previously observed.

On May 15 bronchoscopic examination revealed the presence of an adenoma in the right main bronchus, the diagnosis being confirmed by histologic examination. Sheets and masses of cells in typical arrangement were noted. On June 20, endoscopic removal of the bronchial adenoma by coagulation and biting forceps was carried out. The procedure was well withstood. The convalescence was complicated by hydrothorax, and there was a marked increase of atelectasis following the procedure (Fig. 8b). Microscopic examination of the tissue removed on June 20 showed a small round-cell tumor, which was variously thought to be carcinoma and adenoma. Planigraphy on August 10, 1942, showed a marked decrease in the constriction of the bronchial lumen, but the extrabronchial mass was still present. A bronchoscopic biopsy was again obtained in November 1942, and there was a difference of opinion among the pathologists as to whether this was carcinoma or benign adenoma. A study of all the biopsies, however, led to a final diagnosis of benign adenoma. On examination in January 1943, the patient felt well and had no cough. Occasional small amounts of blood-streaked sputum were still being raised. On Jan. 14, 1943, bronchoscopic examination showed no increase in the size of the tumor of the right main bronchus. The base of the tumor previously removed with biting forceps was again biopsied and a small amount of tissue removed. Some decrease was present in the normal lumen due to the infiltration of the right lateral wall. On March 12, 1943, the patient felt well and was symptomless. There was no cough, dyspnea, or wheezing. Pneumonectomy was discussed, and it was decided not to undertake it because of the proximity of the tumor to the carina.

In August 1943 bronchoscopic examination showed an inflammatory area at the site of the adenoma. Very little impairment of the lumen of the main bronchus was noted and there was no pus or exudate. Biopsy revealed no evidence of tumor.



Fig. 7. Case 4. Bronchial adenoma with extrabronchial mass: postero-anterior roentgenogram exhibiting large mass in right superior mediastinum (arrow). Lateral views indicated that it was anterior in position.

Comment: In this case the presence of an extrabronchial extension of bronchial adenoma led to an erroneous roentgen diagnosis on the original examination. The correct diagnosis was suggested by reason of the typical history and physical findings and was confirmed by bronchoscopy. The planigrams, however, give an accurate picture of the progress of the lesion and the effects of therapy and indicate the exact location sufficiently to discourage attempts at radical surgery.

CASE 5: A male aged 38 was first seen at the University Hospital July 12, 1943. He had a history of cough and pain over the right lower chest for six or seven years, blood in the sputum for the past year, and a feeling of weakness. The cough and sputum had been present for about eight years. The patient dated the process to an appendectomy in 1935, following which a pleurisy developed. When he became excited during the past year, coughing began, he became weak, and sometimes coughed up blood in fairly copious amounts. He had no loss of weight and gave no history of a foreign body. He went to the Sunnyrest Sanatorium, where sputum examination and other studies showed no evidence of tuberculosis.

On physical examination at entrance here there were dullness to percussion over the lower right chest, decreased breath sounds, and increase of

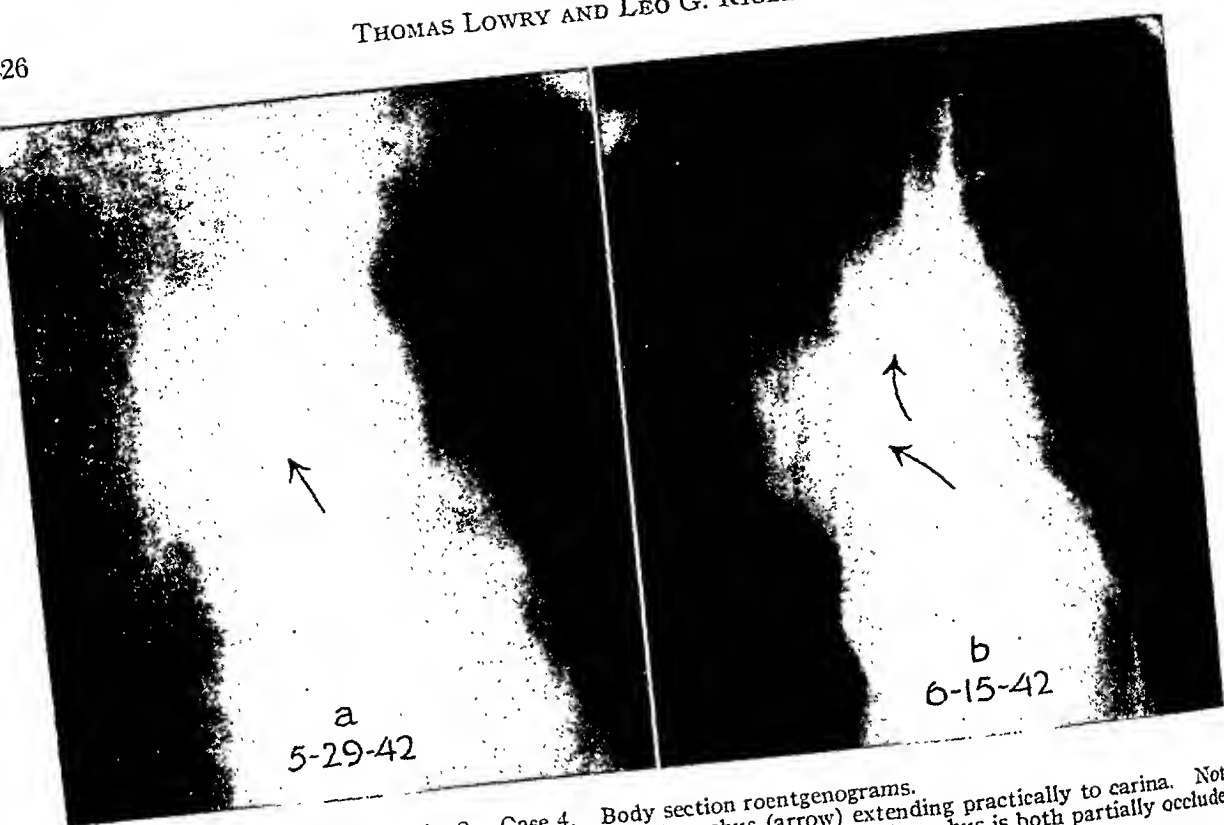


Fig. 8. Case 4. Body section roentgenograms.
 a. Marked constriction of air column in right main bronchus (arrow) extending practically to carina. Note deviation of bronchus, angulation, and filling defect along lateral wall. The bronchus is both partially occluded by the intrabronchial tumor and displaced and compressed by the mediastinal mass.
 b. Planigraphic study after bronchoscopy and hemorrhage. Note the complete occlusion of the air column at the carina by the accumulated blood (arrow) and the large extrabronchial mass (lower arrow). Later planigrams showed a considerable restoration of the airway of the right main bronchus after local removal of the tumor.

whispered voice sound over the lower half of the right chest posteriorly.

Roentgen examinations had been made by Doctor Paradis at the Sunnyrest Sanatorium and sent to one of us (L. G. R.) for interpretation. Bronchography was also carried out there. Further studies were made at the University Hospital, including planigraphy. On the postero-anterior roentgenogram (Fig. 9) there were observed marked density in the right lower lung field, retraction of the mediastinum and heart, and elevation of the diaphragm. The findings were characteristic, but with some "drowned lung" effect as well. On bronchography, a typical rounded, sharply defined cap-shaped defect was made out in the right main stem bronchus just at the level of the middle lobe orifice. Body section roentgenography revealed a round dense shadow within the lumen of the right lower bronchus at the same level (Fig. 10). All the findings were characteristic of a benign tumor.

Bronchoscopy was done on July 22, 1943, by Dr. Logan Leven and showed the right main bronchus to be normal to the level where the right middle lobe branch comes off. At this location there was seen a smooth, round, reddish mass practically filling the lumen, typical of bronchial adenoma. Biopsy was done. On microscopic examination there were found cords and groups of small dark-

staining cells connected by fine bands of connective tissue, typical of adenoma of the bronchus.

Bronchoscopy was again done on July 28, and an effort at cauterization and removal was made, but bleeding occurred and it had to be discontinued. Bronchoscopy was repeated Aug. 6 and cauterization was again done, with some bleeding. This was repeated on Aug. 26. The mass was seen to be larger at this time, completely occluding the right lower lobe and almost completely occluding the middle lobe. Cauterization was again done. Because of the inability to remove the tumor completely, lobectomy was decided upon.

On Aug. 30, 1943, thoracotomy was undertaken by Dr. O. H. Wangenstein. A dense, adherent lung was found. There was pronounced atelectasis of the lower and middle lobes, which could not be inflated. Adhesions between the middle and upper lobes were found, so that the entire right lung had to be removed. It weighed 615 gm.

A large, typical rounded tumor projecting into and almost occluding the right lower lobe bronchus was seen in the specimen. This came within a centimeter of the bifurcation of the right main bronchus and appeared almost to ride over the orifice. Numerous small cavities were found in the lower lobe, filled with tenacious mucus. The bronchi elsewhere appeared normal. There was distinct dilata-



Fig. 9. Case 5. Bronchial adenoma, right lower lobe: postero-anterior roentgenogram showing partial atelectasis and some "drowning" of right lower lobe.

tion of the bronchi just distal to the tumor. Sections of the mass showed typical bronchial adenoma. The lymph nodes showed some sarcoidosis, but the relationship of this to the primary tumor is not clear. The patient had some drainage from the chest but made a fairly uneventful convalescence.

Comment: In this instance a tumorous obstruction of the bronchus with its effects of atelectasis, "drowned lung," and bronchiectasis was fully delineated by the various methods of x-ray examination. The exact location of the obstructing neoplasm and some evidence as to its benign character were clearly brought out. Obviously the bronchoscopic observations and the microscopic evidence of the nature of the tumor are the most certain diagnostic criteria, but the pathological process had been well exhibited by the roentgen examinations alone. Radical surgical procedure was adopted here because of the impossibility of complete local removal of the tumor. It was unfortunate that pneumonectomy became necessary, but recovery is taking place.

CASE 6: A 36-year-old American housewife was seen in the Out-Patient Clinic in August 1940. She presented a history of cough for two years, produc-



Fig. 10. Case 5. Bronchial adenoma, right lower lobe. a. Body section roentgenogram showing complete obstruction of right lower lobe bronchus and cap-shaped shadow of tumor protruding into the bronchus. b. Diagrammatic representation of findings shown in a.

tive of thick, purulent sputum, varying in amount from an ounce to one-half cup in twenty-four hours. This had not been foul, but there had been hemoptysis of 2 ounces or so of bright red blood on four or five occasions during the two-year period. The

patient had not lost weight and had had no fever as far as she knew. Examination of the chest showed slightly diminished expansion of the right side of the thorax. There were decreased breath and voice sounds over the lower third of the right lung posteriorly. No râles were heard and there was no impairment of resonance on percussion. The remainder of the examination was negative. Routine urine and blood examinations showed no abnormalities.

Roentgen examination revealed increased density in the medial portion of the lower right lung field. This was interpreted as probably indicating an area of atelectasis or "drowned lung" in the medial segment of the right lower lobe. A bronchogram showed obstruction of a branch of the right lower lobe bronchus with a rounded filling defect in the lipiodol shadow, fairly characteristic of bronchial adenoma.

At bronchoscopy, done by Drs. Robert Priest and L. R. Boies, a pedunculated, polyp-like mass was seen. This was smooth, movable, and covered by glistening mucous membrane. Biopsy revealed adenoma of the bronchus, and, at a subsequent bronchoscopy, the mass was removed *in toto*. It was attached by a long pedicle.

Three months later the patient had gained seven pounds and was coughing much less, but still raised one-half ounce or so of purulent sputum per day. A bronchogram in April 1941 showed filling of several saccular bronchiectatic pockets distal to the point of obstruction which were not reached by lipiodol injection before removal of the adenoma.

This patient went through a normal pregnancy and was delivered in July 1941. Since then her symptoms have continued to be mild, consisting of a slight cough with less than 5 c.c. of purulent sputum daily and no hemorrhages. Bronchoscopy in April 1942 showed recurrence of the adenoma in the right lower lobe bronchus. Lobectomy was refused and tissue was therefore again removed locally.

When last seen, in November 1942, the patient was in good health, had maintained her weight, and her symptoms were still in abeyance.

Comment: The typical history of hemoptysis was present here. The roentgen findings of bronchiectasis and atelectasis were characteristic. Body section roentgenography was not carried out, but bronchography showed a fairly typical cap-shaped defect. Recurrence of the tumor after local removal is not uncommon.

CASE 7: A boy aged 14 was admitted to the University Hospital Nov. 9, 1931, with a history of what appeared to be an attack of pneumonia in July 1931. Following recovery he coughed a great deal and raised some mucoid sputum. In August his tem-

perature was found to be 102°. X-ray examination was made, and it was thought that he had pus in his chest. Thoracentesis was performed several times without results. The patient was pale and emaciated, the voice and breath sounds were greatly diminished over the right base posteriorly, and there was considerable dullness, also. Moderate leukocytosis was present.

The first x-ray examination, Nov. 9, 1931, revealed a density at the right base, the diaphragm being elevated and partially fixed. This was thought to be an encapsulated interlobar effusion. Exploratory operation was done and the pleura was fixed to the diaphragm. Later it was re-explored and some thick purulent exudate over the surface was found, but no free exudate.

After some efforts at drainage, on Jan. 26, bronchography was done. A partial pneumothorax was present on the right side and there was thickening of the pleura. Complete obstruction of the lower lobe bronchus was found, suggestive of a tumor or inflammatory constriction.

Bronchoscopy was then performed on Jan. 29, and edema of the mucous membrane in the right lower lobe bronchus was observed. A biopsy was done, and the first report was carcinoma. Later the pathologists thought this probably was chronic inflammatory tissue. Bronchography was again done, showing extensive bronchiectasis.

Following the bronchoscopy the patient improved a great deal, the coughing became less, and he began to increase in weight. Considerable dilatation of the bronchus was done through the bronchoscope, with marked improvement. The boy was again examined in 1933 and in 1934. On bronchography in 1934, the obstructed bronchus could be clearly made out. Re-examination of this bronchogram at a later date showed clear evidence of a cap-shaped deformity characteristic of adenoma.

The patient has been seen on repeated occasions since that time, and the biopsy specimens have been re-examined. The pathologists now believe that he has a typical bronchial adenoma. The patient is greatly improved and appears to be well, although there is a chronic atelectasis of the right lower lobe. He has refused further studies and further bronchoscopy, so that it is impossible to determine the exact status of the adenoma at this time.

Comment: This is a characteristic example of the errors which have occurred in the diagnosis of bronchial adenoma. The errors here were made by everyone concerned, including the pathologist, probably owing to lack of familiarity with the condition. Undoubtedly this is a bronchial adenoma which has continued a rather benign course without any particular interference.

SUMMARY

1. The clinical and roentgenologic features of adenoma of the bronchus are described, and its pathology and potential malignancy are briefly discussed.

2. A diagnosis of bronchial adenoma is usually rather easily established by roentgenologic and bronchoscopic examination, once the condition is suspected.

3. Evidence is presented in favor of regarding this tumor as a clinical entity separate from bronchiogenic cancer, even though the two cannot always be distinguished pathologically and in spite of the rare instances in which adenoma gives rise to cancer.

4. The chief reason for this division is a practical one: adenoma of the bronchus has a prognosis quite different from that of cancer and therefore permits the employment of a more conservative plan of therapy in properly selected cases when radical resection would be attended by a large risk.

5. Seven cases are presented to illustrate: (a) the typical clinical features of intrabronchial adenoma; (b) bronchial adenoma with an extrabronchial mass; (c) the various types of roentgen examination used in the diagnosis; (d) the value of body section roentgenography in the delineation of the tumor and in following the effects of treatment; (e) the results of

various types of therapy in the several cases (namely, no treatment, local extirpation, and pulmonary resection).

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Iodinated Organic Compounds as Contrast Media for Radiographic Diagnoses

III. Experimental and Clinical Myelography with Ethyl Iodophenylundecylate (Pantopaque)¹

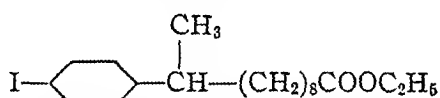
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ETHYL iodophenylundecylate is one of a number of iodinated organic liquids that has been studied as a contrast medium for myelography. This new medium is a mixture of isomeric esters of which the principal constituent is probably that shown in the accompanying formula. It contains 30.5 per cent iodine and has a density of 1.263 at 20°C. The name Pantopaque² was coined for this mixture to provide radiologists and clinicians with a convenient designation. The chemistry of this and of related diagnostic aids is discussed elsewhere (1, 2).



Ethyl iodophenylundecylate (provisional).

Prior to its clinical use, ethyl iodophenylundecylate was tested intrathecally in dogs in a series of comparative experiments against iodized poppy-seed oil. In these tests the new medium proved to be much easier to handle, produced discomfort of shorter duration, and in most of the animals was almost completely absorbed within a year. The clinical results have paralleled those obtained in animal experimentation.

As is shown in Table I, iodized poppy-seed oil is twenty-two times as viscous as ethyl iodophenylundecylate at 25°C., and seventeen times as viscous at 37.5°C.

¹ These studies were aided by a grant from the Research Laboratories of the Eastman Kodak Company. They were presented before the Radiological Society of North America, at its Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30-Dec. 4, 1942, and submitted for publication in June 1944.

² Pantopaque is a registered trade-mark.

TABLE I: COEFFICIENTS OF VISCOSITY OF
MYELOGRAPHIC MEDIA

Medium	$\eta_{25^\circ\text{C.}}$	$\eta_{37.5^\circ\text{C.}}$
Ethyl iodophenylundecylate	0.372	0.217
Iodized poppy-seed oil	8.06	3.76
Ratio	1:22	1:17

Because the new medium is so fluid, it is easily injected or removed with an 18- or 20-gauge needle and flows freely in the spinal canal immediately after injection. In dogs, however, where lumbar punctures

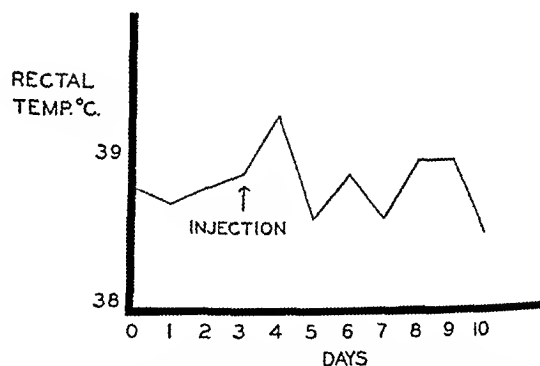


Chart 1. Typical transient fever following intrathecal injection of ethyl iodophenylundecylate in dogs.

are nearly impossible, and where the space relations of the canal are such that both media flow very slowly, practically none of the injected material can be removed.

Following intrathecal injection of 3 to 5 c.c. of ethyl iodophenylundecylate in dogs, there is a period of slight fever, lasting one or two days, as is shown in Chart I. During this time the dogs are clinically well, but a fair proportion may exhibit mild distress when the head is bent. After two or three days, however, this symptom dis-

appears. With iodized poppy-seed oil, on the other hand, there is no fever, but the period of distress when the head is bent may persist for ten to fourteen days. Sections taken from the spinal cords of dogs sacrificed at varying intervals show that both media are encysted after a lapse of about six weeks. The encystment is particularly noticeable in the cauda equina area and is not found generally throughout the cord. Typical sections showing the type of encystment that occurs are reproduced in Figure 1. As is evident from these photomicrographs, the size of the cysts with ethyl iodophenylundecylate is considerably less than that of those produced by iodized poppy-seed oil; this is probably referable to the greater viscosity of the poppy-seed oil. Cord sections taken at intervals from dogs injected intrathecally with ethyl iodophenylundecylate show that the physiological response about the cysts is essentially a foreign body reaction.

Acute toxicities for ethyl iodophenylundecylate were determined by intraperitoneal and intravenous injections. The LD 50 for intraperitoneal injections was found to be 4.6 gm./kilogram for mice and 19 gm./kilogram for rats. Control experiments with iodized poppy-seed oil showed no toxic effects with rats even when the medium was injected intraperitoneally at a level of 25 gm./kilogram. The injected ethyl iodophenylundecylate was completely absorbed in six weeks, however, while the iodized poppy-seed oil was not absorbed during the life of the experimental animal. The more rapid rate of absorption of the new medium may well be the sole cause of its relatively greater toxicity. Intravenous injections in dogs showed that ethyl iodophenylundecylate was without effect at a level of 0.5 gm./kilogram but was lethal at a level of 1.0 gm./kilogram. Emulsification with water containing small amounts of Igepon T (sodium oleyl-methyltaurine) or of methyl cellulose reduced the toxicity considerably, and doses of 1.0 gm./kilogram were given intravenously to dogs with safety.

With the assurance from these experi-

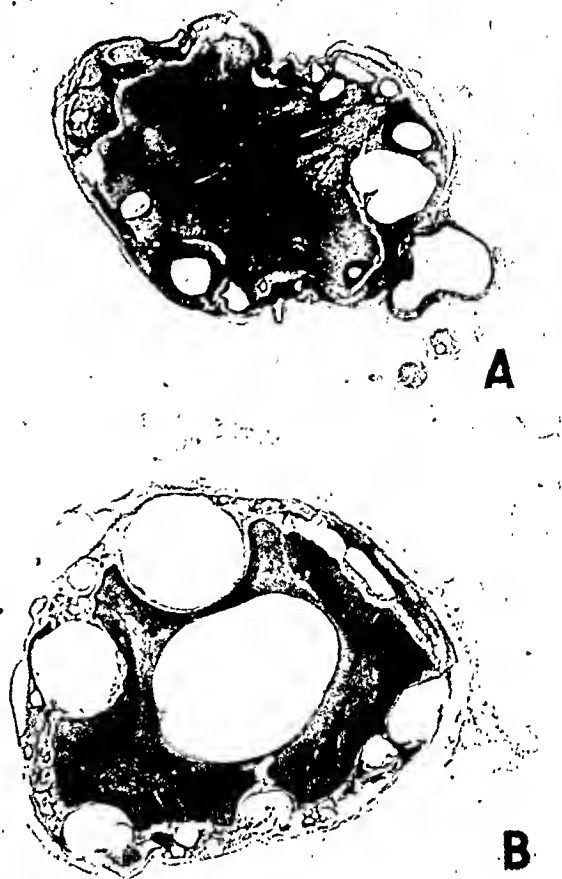


Fig. 1. Cyst formation in the spinal cord of dogs following intrathecal injection of (A) ethyl iodophenylundecylate and (B) of iodized poppy-seed oil. The sections represent extremes in pathology.

mental studies that the new medium was safe, it was first tested clinically on Nov. 23, 1940, by Drs. Paul Garvey and Nathaniel Jones in Case I, reported below. The absence of untoward developments led to its use in 4 additional patients. The satisfactory outcome in these first few cases was followed by a wider use, until now the new medium has been tested in numerous clinics. The most extensive series of cases³ have been compiled by Dr. William P. Van Wagenen (Rochester, N. Y.), Dr. R. Glen Spurling (Louisville, Ky.), and Dr. William V. Cone (Montreal, Canada). From their experience it is evident that the best results are obtained if 3 to 5 c.c. of ethyl iodophenylundecylate are injected and

³ As of November 1942.

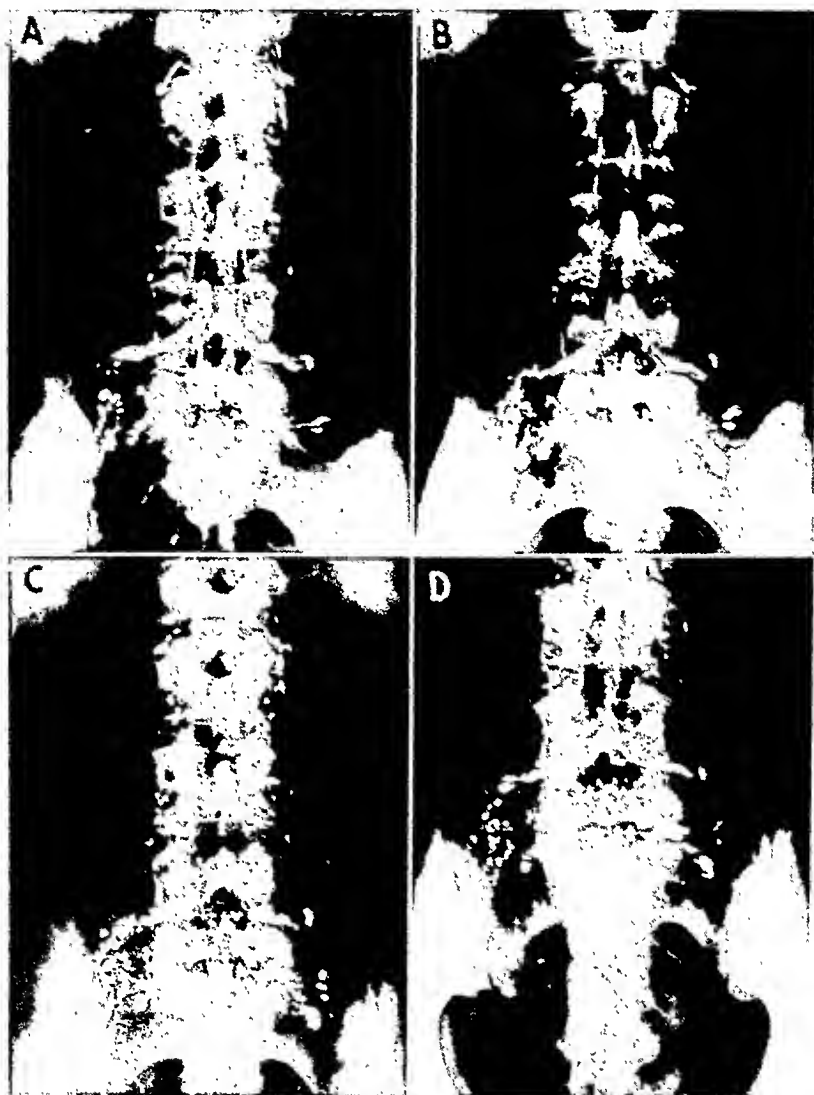


Fig. 2. Case II: Absorption of ethyl iodophenylundecylate in unusual case in which the nerve sheaths are filled with the medium. A. Immediately after injection. B. After three days. C. After forty days. D. After five months.

later removed by the general procedure of Kubik and Hampton (3). In this way up to 90 per cent of the injected medium is easily removed and the small amount of residuum is completely absorbed within a few weeks.

CASE HISTORIES

CASE I (Unit No. 171887): A 53-year-old male with complete paralysis from the waist down as the result of pressure on the dorsal cord from a dissecting aortic aneurysm was injected on Nov. 23, 1940, with 5 c.c. of ethyl iodophenylundecylate at L4 after removal of 8 c.c. of crystal-clear spinal fluid. Fluoroscopy showed a persistent constriction at L3 and L4, and also between L4 and L5. The patient

experienced no reaction from the injection. Death occurred from a rupture of the aneurysm seventeen days later. A postmortem examination showed that the contrast medium was still mobile. Sections (Fig. 3) of the spinal cord showed a few polymorphonuclear cells around the nerve roots. There was no evidence of encystment in any portion of the cord.

CASE II (Unit No. 173025): A 28-year-old white male with embryoma of the left testicle with bone and pulmonary metastases was injected with 5 c.c. of ethyl iodophenylundecylate on Jan. 7, 1941. Films (Fig. 2) taken at intervals up to May 29, 1941, show a gradual absorption of over half of the injected contrast medium. Immediately after injection the Pantopaque became immobile as a result of filling the nerve sheaths, particularly the sheaths of the sciatic nerves. During the week immediately

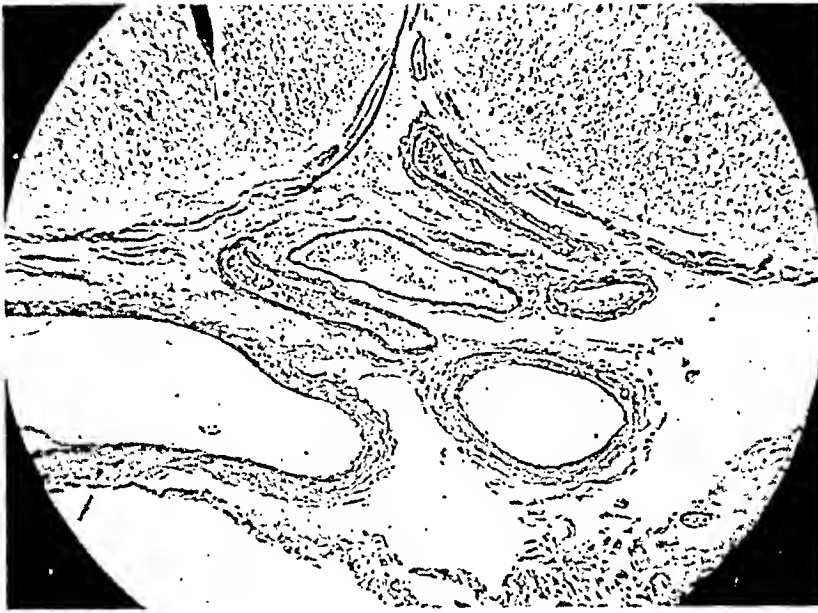


Fig. 3. Case I: Section from the spinal cord seventeen days after injection of ethyl iodophenylundecylate. A few polymorphonuclear cells are seen.

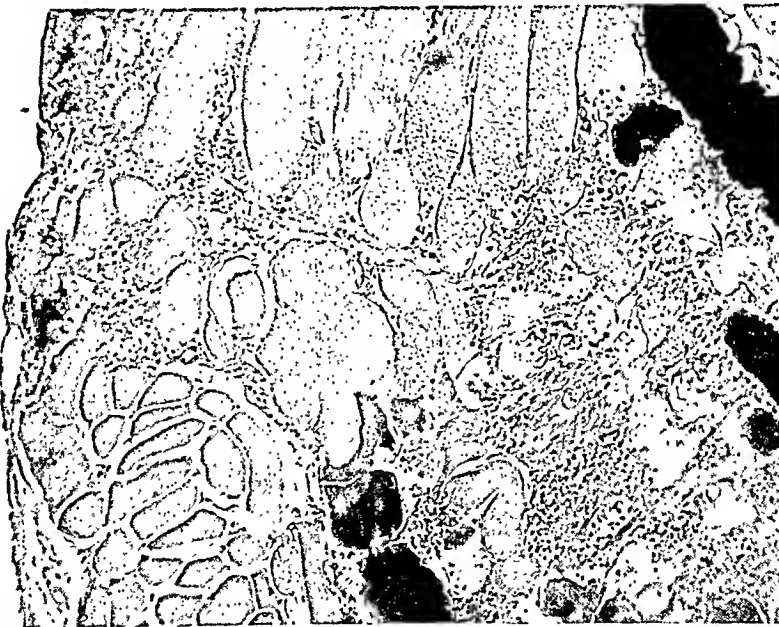


Fig. 4. Case III: Reaction about probable site of extradural injection of ethyl iodophenylundecylate.

following the injection, the patient had a slight paresthesia in the lower leg. Otherwise there were no clinical symptoms. Death occurred at home and an autopsy was not obtained.

CASE III (Unit No. 183121): A 29-year-old female with clinical symptoms of a ruptured nucleus pulposus was injected on Sept. 9, 1942, with 3 c.c. of ethyl iodophenylundecylate. A diagnosis of extramedullary compression between L4 and L5 was

somewhat equivocal. The contrast medium was removed and the patient was placed on fracture boards. On Sept. 21, 1942, 3 c.c. of Pantopaque was again injected, but fluoroscopy showed that some of it was extradural. For several days the patient experienced increased leg pain, especially after manipulation. Finally, on Sept. 28, 1942, a third examination was made with 3 c.c. of ethyl iodophenylundecylate and a positive diagnosis of a

lesion at the disk space of L4 on the left side was obtained. A laminectomy was performed on Sept. 30. A section taken at the probable site of the extradural injection showed striated muscle and fibrous tissue. In the section reproduced in Figure 4 dense fibrous connective tissue is seen having a structure consistent with that of ligamentum flavum. In this tissue there is no evidence of any inflammatory reaction. Other portions of the section show striated muscle and areas of fairly loose connective tissue. Some of the striated muscle bundles appear to contain more than their normal number of nuclei, while others show considerable degenerative change. Instead of normal striated myofibrils the muscle sheaths contain a granular debris. This degeneration could be due to some local irritant, but similar changes are often seen without any known foreign matter in the vicinity. Several areas of the less dense connective tissue show infiltration by polymorphonuclear leukocytes in addition to many small round cells and a few larger monocytes. No definite droplets of contrast medium are seen, and there is no localized focal necrosis or abscess formation.

SUMMARY

Ethyl iodophenylundecylate (Pantopaque), a new contrast medium for myelography, is more fluid and is therefore more easily injected and removed than previously described oil-type contrast media. In addition to these physical advantages, the medium is absorbed from the subarachnoid space with relative rapidity.

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DISCUSSION

Capt. Frank H. Mayfield, M.C. (Percy Jones General Hospital, Battle Creek, Mich.): Doctor Strain and his co-workers have developed a material which, to my mind, is the most satisfactory for myelography that is yet available. That little is said in their paper of the clinical value of this material reflects the extreme conservatism of the men who have worked with Pantopaque, and this attitude is further evidenced by the rigid control which they have maintained over the product during its experimental stage.

I first became familiar with Pantopaque in January 1942. Prior to that time, Major Spurling and Major Bell of Louisville had used it a great deal

and, on their recommendation, some was forwarded to me for experimental clinical use as a check on their results. I was not aware at the time of the work being done at other clinics except at the University of Rochester.

We had been using lipiodol for myelography and for the most part had found it a fairly satisfactory contrast medium. There were, however, two outstanding objections to its use. First, it is a very viscid oil with high surface tension and at times, on fluoroscopy, we saw filling defects which we thought were due either to herniated disk or tumor, which at operation proved to be small normal anatomical variations. Second, we found it difficult to remove lipiodol completely, because of its tendency to break up into droplets and its viscosity.

Our experience with pneumomyelography had never been satisfactory, though I am thoroughly aware of the excellent results obtained by Doctor Chamberlain in Philadelphia and Doctor Camp and his associates at the Mayo Clinic, and, indeed, by many other groups.

Pantopaque has solved many problems. It is a much less viscid oil than lipiodol, it moves within the spinal canal more rapidly, and because of its lessened surface tension it fills the root sleeves better and does not show false filling defects. Furthermore, it is easily removed. In most instances, one can recover by simple aspiration nearly all of the material, the usual experience being to leave one or two minute droplets.

The technic for removing the oil is that described by Hampton and Kubik. Lumbar puncture is done with the patient lying on his face, the needle being inserted at either the fourth or fifth interspace and carried through until it touches the anterior wall. The oil is then collected about the end of the needle under fluoroscopic observation, after which it is removed by simple aspiration.

Prior to entering the Army, I had used Pantopaque in approximately 30 cases. In most of them the oil was removed, but in 2 cases it was not removed. The cases in which the oil was removed showed no meningeal reaction. Those in which some of the oil was left showed a mild cellular response, and in one of the two in which none of the oil was removed, a mild meningismus occurred, lasting about three days. No residual symptoms were observed.

The highest cellular reaction was one thousand cells at the end of forty-eight hours. The usual count after administration of Pantopaque was 25 to 50 cells. This is almost identical with our experience with lipiodol. I think, therefore, that the toxic potentialities of the two drugs are the same.

Pantopaque, however, has two outstanding advantages. First, it is a more satisfactory medium for diagnostic purposes. Second, it can be removed more completely and more easily than lipiodol, thereby overcoming the one outstanding objection to the use of contrast media, namely, the medico-legal objection to leaving in the spinal canal a

foreign body which is visible on the x-ray plate.

Dr. Strain has mentioned the comparative absorbability of Pantopaque and lipiodol, and from my experience I find that Pantopaque is absorbed, or rather loses its radiopacity, much more rapidly than lipiodol. In those cases where only a few droplets of Pantopaque were left, it was no longer demonstrable after two to four months. In the two instances where about 3 to 4 c.c. of oil was left, it could not be shown on x-ray plates six months later. Lipiodol is visible usually for two to four years, and

occasionally never disappears. While, as recommended by the author, Pantopaque should be removed, in the event that one is not successful in removing it, I am convinced that no harm will result.

There is one situation in which lipiodol is slightly more satisfactory than Pantopaque. Lesions of the cervical area are sometimes difficult to visualize with Pantopaque because the oil moves so rapidly that the defect is missed. With the more viscous lipiodol, small cervical deformities will be seen that might be missed with Pantopaque.



Iodinated Organic Compounds as Contrast Media for Radiographic Diagnoses

IV. Pantopaque Myelography¹

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SINCE THE introduction of Pantopaque² in 1941 as a diagnostic aid in contrast myelography (1), 150 Pantopaque myelograms have been made at Strong Memorial and Rochester Municipal Hospitals. The fluidity of the new medium has greatly simplified myelography, and, through this property, the results obtained in the demonstration and study of minimal and maximal defects of the subarachnoid space have been especially satisfactory. Analysis of the results shows that the accuracy of Pantopaque myelography, based on cases that have come to operation, is 95 per cent. Errors both in the use of the medium and in the radiological interpretation appear to be due more to subjective factors than to Pantopaque itself; thus, in the series reported here, most of the errors occurred among the first 50 cases. Since a personnel of varied degrees of experience was involved, these errors probably represent the training period required to obtain high accuracy.

MYELOGRAPHY WITH PANTOPAQUE

Pantopaque is particularly satisfactory in contrast myelography of the lumbar and cervical regions of the spine. The series reported here, however, includes so few cervical myelograms that the discussion will be limited to the lumbar region.

To reduce the excretory load on the body to a minimum, Pantopaque should always be removed from the spinal canal after the examination has been completed. This is easily accomplished by the procedure of Kubik and Hampton (2) provided a satisfactory mid-line puncture is made for the

injection of the medium. With a good mid-line puncture the examination, including injection and removal, usually may be completed within fifteen to twenty minutes.

Position of Patient: The patient is placed prone on a tilting fluoroscopy table with the head turned to either side. The hands grasp the edge of the table top at the level of the shoulders so that they will be out of the way, and so that the patient can steady himself during the examination. A small pillow is placed under the lower portion of the abdomen in order to straighten the lumbar curve moderately. The feet are placed firmly against the footrest of the tilt table.

Injection of Pantopaque: Sterile precautions should be employed as in a routine lumbar puncture. The injection is made in the mid-line, usually between the third and fourth lumbar spinous processes. If a lesion is suspected at that level, however, the interval above or below (preferably below) should be selected. If injection in the lumbar subarachnoid space is not feasible, cisternal injection may be employed. After the skin and the subcutaneous tissues have been anesthetized by infiltration with procaine, an 18- or 20-gauge needle, preferably with short bevel, is introduced into the subarachnoid space. After the ligamentum flavum has been encountered, the needle is inserted gradually, with great care. When the operator is certain that the needle has entered the subarachnoid space, the stylet is removed, and 3 to 5 c.c. of spinal fluid is aspirated and collected for protein determination. A previously prepared 5-c.c. syringe containing 3 c.c. of Pantopaque is then secured to the adaptor of the needle

¹ Accepted for publication in July 1944. Aided by a grant from the Research Laboratories of Eastman Kodak Co., Rochester, N. Y.

² Registered trade-mark.

and the contrast medium is slowly injected. This should be accomplished easily; if marked resistance is encountered, the exact position of the needle should be checked. When the Pantopaque has been introduced into the subarachnoid space, the syringe is detached from the needle and the stylet is replaced. A sterile gauze dressing is then placed over the needle and the patient is ready for the examination.

Fluoroscopy and Roentgenography: After the examiners have become dark-adapted, a fluoroscopic examination is made. The Pantopaque should be seen pooled in the middle lumbar region and near the point of the needle. Normal landmarks are then determined so that each interspace may be recognized on examination. A marker is applied to the back of the patient to label and to lateralize the films. Should the amount of injected Pantopaque prove to be too small, because of a large subarachnoid space, an additional 3 c.c. should be injected. The foot of the tilt table is first lowered gradually, and the flow of the column of Pantopaque is studied carefully. When the Pantopaque has collected in the terminal portion of the subarachnoid space, the table is then tilted slowly in the opposite direction, and the flow of the medium is again observed. To prevent the Pantopaque from passing into the cranial ventricles, where it may be immobilized, or from flowing too rapidly over the lumbar curve, which may lead to globulation, the examiners should avoid lowering the head of the patient too rapidly. These maneuvers may be repeated until a satisfactory examination has been completed. Sometimes it may be desirable to roll the patient from side to side in order to study each root adequately.

During fluoroscopy the movement of the image of the column of Pantopaque is observed closely for deviations in flow. If the image is indented, or if the flow of the column is partially or completely arrested, the behavior of the Pantopaque in the region of the vertebral column in which the defect occurs is carefully studied. Postero-anterior roentgenograms are taken rou-

tinely to demonstrate the third, fourth, and fifth lumbar intervertebral disk spaces. To demonstrate medially located lesions, the postero-anterior views may be supplemented with lateral and lateral-posterior roentgenograms. Defects demonstrated must be constant, and there must be agreement among the observers as to their presence before concluding the examination. Average technical factors that may be employed for the spot films are as follows: distance, 25 inches; kv. p., 85; ma., 100; time, 1/10 to 3/10 second, depending on the thickness of the patient. The area under investigation is diaphragmed as closely as possible to provide the maximum contrast possible. For the lateral and lateral-posterior views a Potter-Bucky diaphragm should be employed. It is essential that the fluoroscopic table be equipped with an efficient apparatus that permits rapid switching from fluoroscopy to roentgenography.

Removal of Pantopaque: At the completion of the examination, the Pantopaque is collected around the tip of the needle under fluoroscopic visualization and aspirated by means of an empty sterile syringe attached to the lumbar puncture needle. It is usually possible to remove 80 or 90 per cent of the injected Pantopaque without difficulty, but success in removing all the medium is determined usually by the accuracy with which the mid-line puncture was made. The amount removed can be identified in the barrel of the syringe, where it forms a layer under the spinal fluid simultaneously aspirated. Sometimes it is necessary during aspiration to turn the needle gently when its bevel becomes blocked by a nerve root or a meningeal margin. Occasionally the medium must be maneuvered under the tip of the needle two or three times under fluoroscopic visualization before all of it can be removed. In rare instances all these procedures are unsatisfactory, in which case the simplest practice is usually to make another lumbar puncture at a lower level, for example between L5 and S1. At all events, before removing the needle a roentgenogram should be taken

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IV. Pantopaque Myelography¹

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SINCE THE introduction of Pantopaque² in 1941 as a diagnostic aid in contrast myelography (1), 150 Pantopaque myelograms have been made at Strong Memorial and Rochester Municipal Hospitals. The fluidity of the new medium has greatly simplified myelography, and, through this property, the results obtained in the demonstration and study of minimal and maximal defects of the subarachnoid space have been especially satisfactory. Analysis of the results shows that the accuracy of Pantopaque myelography, based on cases that have come to operation, is 95 per cent. Errors both in the use of the medium and in the radiological interpretation appear to be due more to subjective factors than to Pantopaque itself; thus, in the series reported here, most of the errors occurred among the first 50 cases. Since a personnel of varied degrees of experience was involved, these errors probably represent the training period required to obtain high accuracy.

MYELOGRAPHY WITH PANTOPAQUE

Pantopaque is particularly satisfactory in contrast myelography of the lumbar and cervical regions of the spine. The series reported here, however, includes so few cervical myelograms that the discussion will be limited to the lumbar region.

To reduce the excretory load on the body to a minimum, Pantopaque should always be removed from the spinal canal after the examination has been completed. This is easily accomplished by the procedure of Kubik and Hampton (2) provided a satisfactory mid-line puncture is made for the

injection of the medium. With a good mid-line puncture the examination, including injection and removal, usually may be completed within fifteen to twenty minutes.

Position of Patient: The patient is placed prone on a tilting fluoroscopy table with the head turned to either side. The hands grasp the edge of the table top at the level of the shoulders so that they will be out of the way, and so that the patient can steady himself during the examination. A small pillow is placed under the lower portion of the abdomen in order to straighten the lumbar curve moderately. The feet are placed firmly against the footrest of the tilt table.

Injection of Pantopaque: Sterile precautions should be employed as in a routine lumbar puncture. The injection is made in the mid-line, usually between the third and fourth lumbar spinous processes. If a lesion is suspected at that level, however, the interval above or below (preferably below) should be selected. If injection in the lumbar subarachnoid space is not feasible, cisternal injection may be employed. After the skin and the subcutaneous tissues have been anesthetized by infiltration with procaine, an 18- or 20-gauge needle, preferably with short bevel, is introduced into the subarachnoid space. After the ligamentum flavum has been encountered, the needle is inserted gradually, with great care. When the operator is certain that the needle has entered the subarachnoid space, the stylet is removed, and 3 to 5 c.c. of spinal fluid is aspirated and collected for protein determination. A previously prepared 5-c.c. syringe containing 3 c.c. of Pantopaque is then secured to the adaptor of the needle

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² Registered trade-mark.

of Pantopaque in contrast myelography. In the first case (Fig. 2) there is a minimal defect with an absent root. Defects of this type are easily shown with Pantopaque, although such a lesion is seen more clearly on the roentgenogram than during fluoroscopy. For this reason it is desirable to



Fig. 2. Minimal defect with absent root at L4.

process the films during the course of the examination, so that it will not be necessary to repeat the injection and removal of the medium should the results be equivocal. In the second case (Fig. 3) a rather unusual multiple defect is shown in the myelogram. Here, too, the fluidity of Pantopaque is responsible for the result. These illustrations serve to emphasize that the extremes are usually the most difficult defects to demonstrate accurately. Defects intermediate in size are readily recognized both during



Fig. 3. Multiple defects at L3 and L4.

fluoroscopy and roentgenographically. Complete obstructions, particularly those at L5, are frequently difficult to differentiate from congenital variations of the sac in this area. In this connection, the studies of Horwitz (3) on the anatomical variations of the lower lumbar and sacral regions show that the termination of the caudal canal varies greatly from individual to individual. In those cases where a high termination of the lumbar sac is seen during fluoroscopy, a roentgenogram should be taken with the patient in a nearly erect position. The differentiation between a high termination and a block can be determined usually from the film. A high termination will show a tapering of the lumbar sac with the sacral root sleeves clearly evident, whereas a block will present an abrupt transverse cut-off of the Pantopaque column.

DISCUSSION

When Pantopaque was developed (1), an absorbable medium was the goal. Subsequent experience has shown that the fluid character of the new medium is an equally valuable property. Because of the fluidity of Pantopaque, myelography may be carried out rapidly and with great accuracy, as is shown in this series. Similar conclusions have been reached by Spurling and Thompson (4) and by Bradford (5)³. Detailed discussion of the types of defects seen on the myelograms is unnecessary, since they are essentially the same as those obtained by the more viscous iodized oils. These defects have been well described by Hampton and Robinson (6), Camp (7), Robinson (8), and Hyndman, Steindler, and Wolkin (9), and have been summarized by Bradford and Spurling (10).

Although the fluidity of Pantopaque is regarded usually as an asset, it has been cited by Pugh (11) as a disadvantage, in that the medium flows too easily and may globulate as it passes over the lumbar curve. In the series discussed in this paper, globulation has been uncommon and, where it has occurred, the globules could be reunited easily. The same experience has been reported by Hyndman, Steindler and Wolkin (9).

In spite of an extended experience with Pantopaque over a period of three years, the rate of absorption of the medium in man cannot be given with any exactness. If the conditions within the spinal canal are such that a marked degree of globulation of the residual Pantopaque occurs, or if the medium is spread over a large surface, the rate of absorption in man appears to approach the rate of 3 c.c. per year that was noted in dogs (1). On the other hand, when the medium is contained in the cauda equina region, the rate of absorption is so slow that it may be of the order of 0.5 to 1.0 c.c. per year. Provisionally, the rate

of absorption may be set at 1 c.c. per year. Observations by several groups, particularly by Wyatt and Spurling (12), confirm this value.

SUMMARY

The results in 150 cases of Pantopaque myelography show that use of the new medium simplifies the procedure and leads to high accuracy. The technic of lumbar myelography is described in detail.

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³ Editor's Note: See also SCOTT, W. G., AND FURLOW, L. T.: Myelography with Pantopaque and a New Technic for Its Removal, in this issue of *RADIOLOGY*, pp. 241-249.

Myelography with Pantopaque and a New Technic for Its Removal¹

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AS THE TREATMENT of intraspinal protrusion of intervertebral disks becomes more common, increasing efforts are being made to find a simple and accurate but safe objective method for the diagnosis of this disorder. Without entering into a detailed discussion, it is safe to state that neither air, lipiodol, nor thorotrast has proved to be the ideal contrast medium. With air there is often insufficient contrast for clear definition of minor protrusions. With lipiodol the removal of the oil is often inadequate and at times uncomfortable for the patient. Removal of thorotrast is time-consuming and usually incomplete, so that its use is not without risk.

In an effort to find a more satisfactory medium, Warren, Strain, Plati, and associates (1, 2) developed ethyl iodophenylundecylate, a mixture of isomers obtained by the addition of iodobenzene to ethyl undecylate in the presence of aluminum chloride. It contains 30.5 per cent of iodine in firm organic combination. It is called "Pantopaque." The chemistry and the clinical uses of this product were described at the 1942 meeting of the Radiological Society of North America. These investigators state that Pantopaque is slowly absorbed from the spinal canal—3 c.c. being absorbed within a year. It is a clear, colorless oil, less viscid and lighter than lipiodol but heavier than spinal fluid. It is considered to be inert, and so far there have been no reports that it produces an irritation of the meninges.

Because of these properties, Warren and his associates were able to aspirate it more easily from the spinal canal and recommended it as a medium for myelography. The product was manufactured by the Eastman Kodak Company, and its distribution was limited to the Armed Forces during the trial period. The second clinical report was made by Spurling and Thompson (3), who used Pantopaque in over 200 cases. Their results were so satisfactory that "Pantopaque myelograms are made routinely on all disk patients at the Walter Reed General Hospital, where surgery is contemplated." They, like the Warren group, removed the oil by aspiration with a syringe.

The purpose of this paper is (1) to relate our experiences with Pantopaque; (2) to describe a new and satisfactory method for the removal of the oil; (3) to comment briefly on the indications for spinal myelography.

Pantopaque in our experience has been a satisfactory contrast medium for spinal myelography. It is of about the same opacity and hangs together in one mass almost as well as lipiodol. The glass ampule in which it comes contains 3 c.c., a sufficient quantity. Its use has produced no reactions of which either we or the patients are aware. Its great advantage lies in the fact that it is much easier to remove from the spinal canal than lipiodol. All in all, we consider it superior to other contrast media and will continue to use it until something better is developed.

The radiographic examination is done in the usual way. Thirty minutes prior to the examination the patient is given a quarter of a grain of morphine sulfate hypodermically to allay his anxiety and to make him a little drowsy. This is not

¹ The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

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L 4

L 5

S 1

Relaxed

During Valsalva

After Removal

Fig. 1. Demonstration of the changes in the column of opaque oil produced by increasing the intraspinal pressure during the Valsalva experiment to remove the oil at the completion of x-ray examination. The column of Pantopaque during the Valsalva experiment is narrowed; it moves cephalad a distance of about 2.0 cm., and it is lengthened in the longitudinal axis. The spinal fluid, being lighter and more fluid, is moved away from the heavier oil. In this way the oil under pressure is brought into intimate contact with the needle and will bubble out of it without the use of a syringe and forced suction. For case report see foot of opposite page.

L 3

L 4

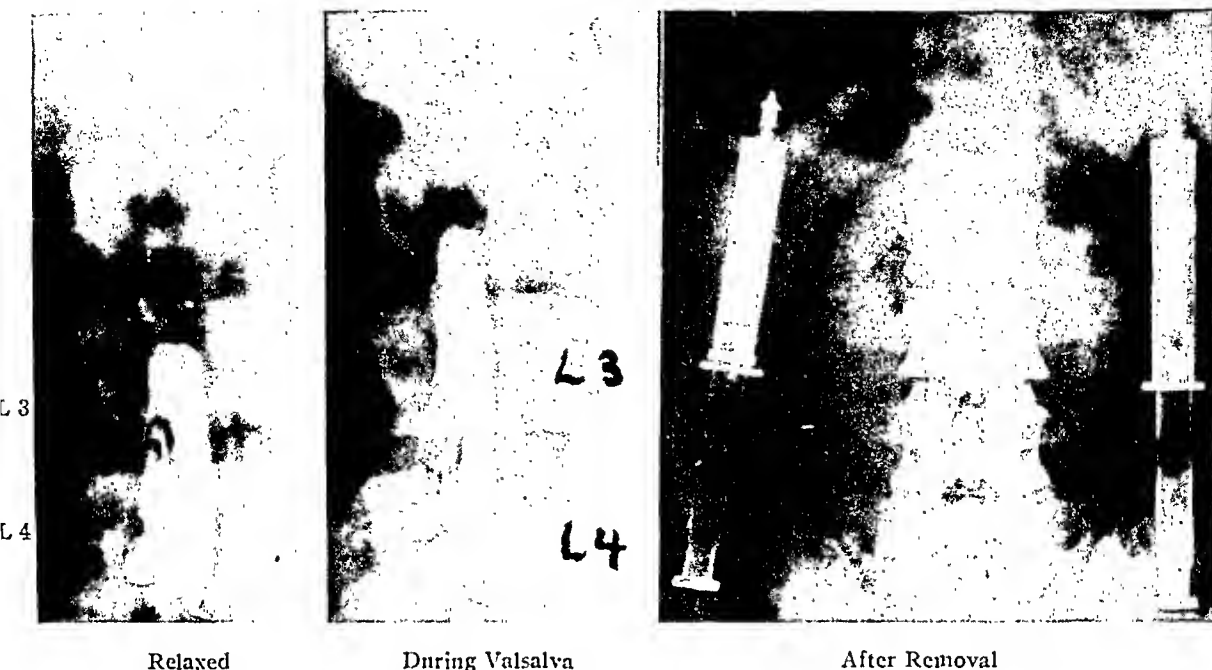
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During Valsalva

After Removal

Fig. 2. In some patients extreme changes occur in the movement of the oil column with variations in the intraspinal pressure. This patient was very restless and apprehensive throughout the radiographic examination. During the Valsalva maneuver there was a marked cephalad movement of the oil column, the total shift being 5 to 6 cm. The movement was very fast. The oil would shoot past the needle with very little bubbling out. It is interesting that in all cases the oil column always moved cephalad even when the patient was almost erect. Furthermore, with the patient in a 60° erect position and the oil column flowing caudad, a sudden forced expiration against the closed glottis would stop the downward course of the oil and cause it to move cephalad. Lack of cooperation rather than the extreme movement of the oil was the cause for the failure to remove the oil in this case. For case report, see foot of opposite page.



Relaxed

During Valsalva

After Removal

Fig. 3. Pantopaque is a satisfactory contrast medium for the routine localization of protruded disks, especially since it can be removed by utilizing physiological mechanisms for increasing the intraspinal pressure.

CASE 3: F. A. S., water tender, second class, age 33, suffered attacks of "lumbago" during the past four years. In the last four months there had been a gradually increasing back pain accompanied by right sciatic pain. These pains were aggravated by sneezing and coughing. The ankle jerks were equal, but there was hypesthesia over the lateral aspect of the right leg. During the myelographic examination a protruded disk was found between the third and fourth lumbar vertebrae on the right. The patient was operated upon, with relief of symptoms, and returned to duty.

necessary, but it puts the patient at ease and makes him more co-operative. The lumbar puncture is done with the patient lying on his side. The needle should be inserted squarely into the center of the spinal canal to facilitate the removal of the oil. When the needle is in the proper position, the spinal fluid flows out freely. Three cubic centimeters of fluid are then removed and 3 c.c. of Pantopaque are injected. The stylette is replaced in the needle and the patient turns over on his stomach and stretches out on the radiographic table. The lumbar puncture needle

remains in place throughout the examination.

The usual fluoroscopic study of the lumbar subarachnoid space is carried out, the patient being tilted slowly up and down so that the oil is retained in a single mass and flows over each disk in the prone and in both oblique positions. A spot-film device is used, and instantaneous exposures are made of all filling defects or those even faintly suspicious.

At the completion of the radiographic examination the patient remains in the prone position and the cranial portion of

CASE 1 (Fig. 1): J. P., seaman, second class, age 24, six months prior to admission strained his back, lowering a boat. Shortly thereafter he began having right sciatic pain. Examination revealed a diminished right ankle jerk and hypesthesia over the lateral aspect of the right leg and foot. Myelography showed a definite but slight narrowing of the oil column opposite the fifth intervertebral disk. A ruptured disk was removed at operation and symptoms were relieved.

CASE 2: J. W. H., (Fig. 2): Marine private first class, age 23, had complained of pain in the low back and right hip at intervals for the past three years. It had been worse the past six months. The neurological and myelographic examinations were negative.

With this long history of back pain and apparent inability to perform his military duties, it was important to rule out the possibility of a protruded disk before transferring the man for medical treatment and ultimate discharge. Myelography in such cases can be helpful in ruling out malingering.



Fig. 4. Pantopaque is preferable to air in most instances for the detection of minor displacements of the axillary sheaths caused by protruded disks. The axillary sheath for the fifth lumbar nerve on the left is incompletely filled and is displaced slightly upward. This minor defect is often difficult to observe on air myelograms.

CASE 4: W. N. F., Marine corporal, age 24, had experienced a gradually developing pain in the low back and down the back of the left leg for the past four months. He received intensive orthopedic treatment, including a fasciotomy, without relief. The neurological examination was negative.

This case illustrates the point that the clinical diagnosis of protruded disks is not always easy and simple; otherwise the patient might have been spared the orthopedic measures. It indicates, also, that not all the physicians coming in contact with these patients possess the same superior background, experience, diagnostic acumen, and surgical skill.

the column of oil is flowed beneath the tip of the lumbar puncture needle. The stylette is removed and spinal fluid bubbles out of the needle. No syringe is attached to the needle and no effort is made to aspirate the oil by suction, since in so doing the nerve roots are frequently pulled against the needle and cause pain as well as block the exit of the oil. Instead, the patient is told to take a deep breath and to bear down as if he were attempting to move his bowels. This, of course, is Valsalva's well-known experiment of forced expiration against a closed glottis and has the effect of increasing the intraspinal pressure.

During the Valsalva maneuver, two things happen to the column of opaque oil: first, the whole column tends to move

cranial a distance of from 0.5 cm. to as much as 5 to 8 cm.; second, the column becomes narrowed (Figs. 1-3). These changes are the result of an engorgement of the venous plexuses that surround the dura and can be demonstrated by taking spot films before and during forced expiration against the closed glottis. During the period of increased intraspinal pressure, the spinal fluid, which is very thin and lacks viscosity, is displaced, leaving the oil in more intimate contact with the tip of the needle so that it can be expelled. The oil comes bubbling out of the needle, usually in droplets interspersed with spinal fluid. The Valsalva maneuver is repeated as often as is necessary until all the oil is removed. As a rule, this is accomplished within twenty minutes, but occasionally it

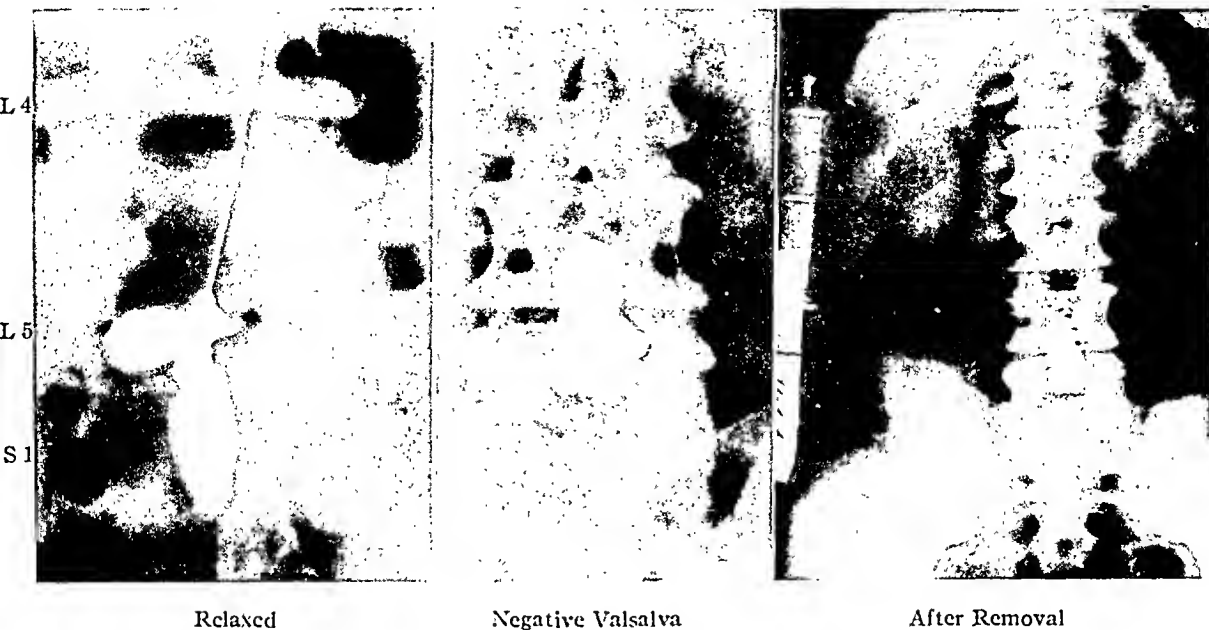


Fig. 5. Pantopaque myelography can be used to advantage when the clinical and neurological findings are not absolutely typical and air myelograms are not definite. In such cases myelography with Pantopaque can be a helpful factor in the detection of a protruded disk or the demonstration of normal disks to eliminate an exploratory operation.

CASE 9: J. F., chief machinist's mate, age 41. Air myelograms had been done previously in this case and had not afforded decisive information. On May 14, 1943, an exploratory laminectomy was done for a suspected ruptured disk. Both the fourth and fifth disks were examined, but no herniation of the nucleus pulposus or a protruded disk was found. The dura was opened and no tumor was seen. Later the patient was transferred to this hospital, still complaining of back pain, although the pain in his leg was almost entirely relieved. Examination revealed a decreased knee jerk and an area of hypesthesia over the region of the fourth lumbar dermatome.

With Pantopaque as the contrast medium, a myelographic examination revealed a complete block of the subarachnoid space at the upper limits of the laminectomy and a narrowing at the lower limits due to postoperative adhesions. No disk changes were observed. Since no abnormal disk changes were found at operation and none during myelography, the disks can be considered normal. It is our opinion that the laminectomy might have been avoided by doing the myelographic examination first. This patient was subsequently referred to the orthopedic service for disposition.

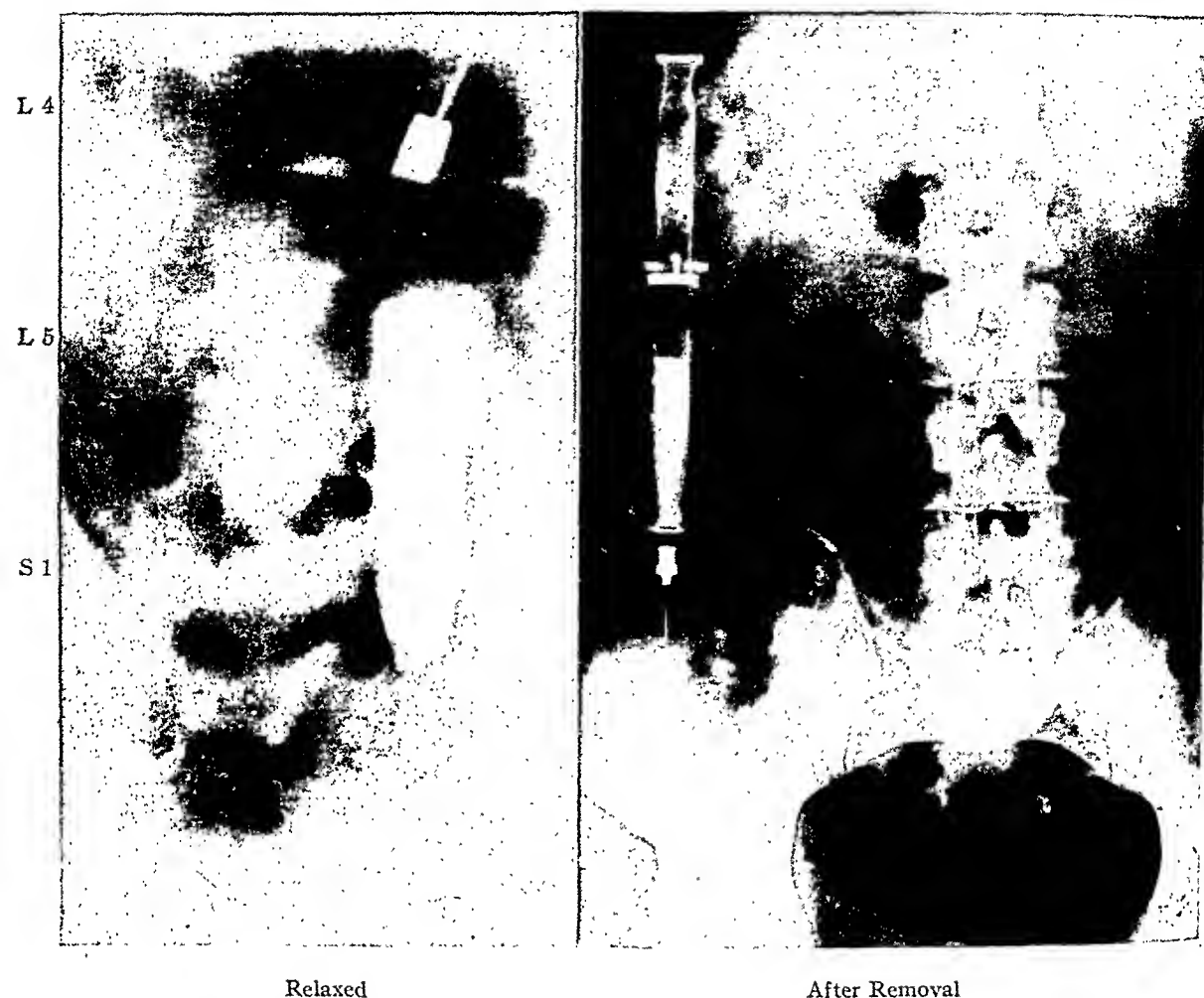
This case is one of the few in which the oil was not successfully removed. The needle was accidentally and unknowingly pushed outside the space containing the oil, as is shown on the films.

may take as long as forty minutes. At intervals the patient is examined fluoroscopically and the table is adjusted to keep the diminishing oil column beneath the tip of the needle.

By this method we have been able to remove all but a few drops of the oil in every case in which any oil at all was expelled. Out of 50 cases we have had two failures. In one patient who had had a previous lumbar laminectomy with intradural exploration, there were intradural adhesions, and it was thought that they were responsible. On reviewing the films, however, it was discovered that the needle had been moved out of the subarachnoid space during the examination. The second failure was in a very uncooperative

patient and was due to this cause rather than any other (Fig. 2). In the initial examinations the removal of the oil was not accomplished with the greatest of ease and required some persistence but, at that, we believe it is a simple, quick, and efficient method, while it has the added advantage that it does not cause the patient pain.

This brings us to the question: "Is contrast myelography necessary?" This is a pertinent inquiry, particularly in view of the opinion of some (4, 5) that it is not necessary and should be dispensed with. Basically, this difference of opinion can be explained by the fact that not all surgeons specializing in this field have the same background, experience, diagnostic acu-



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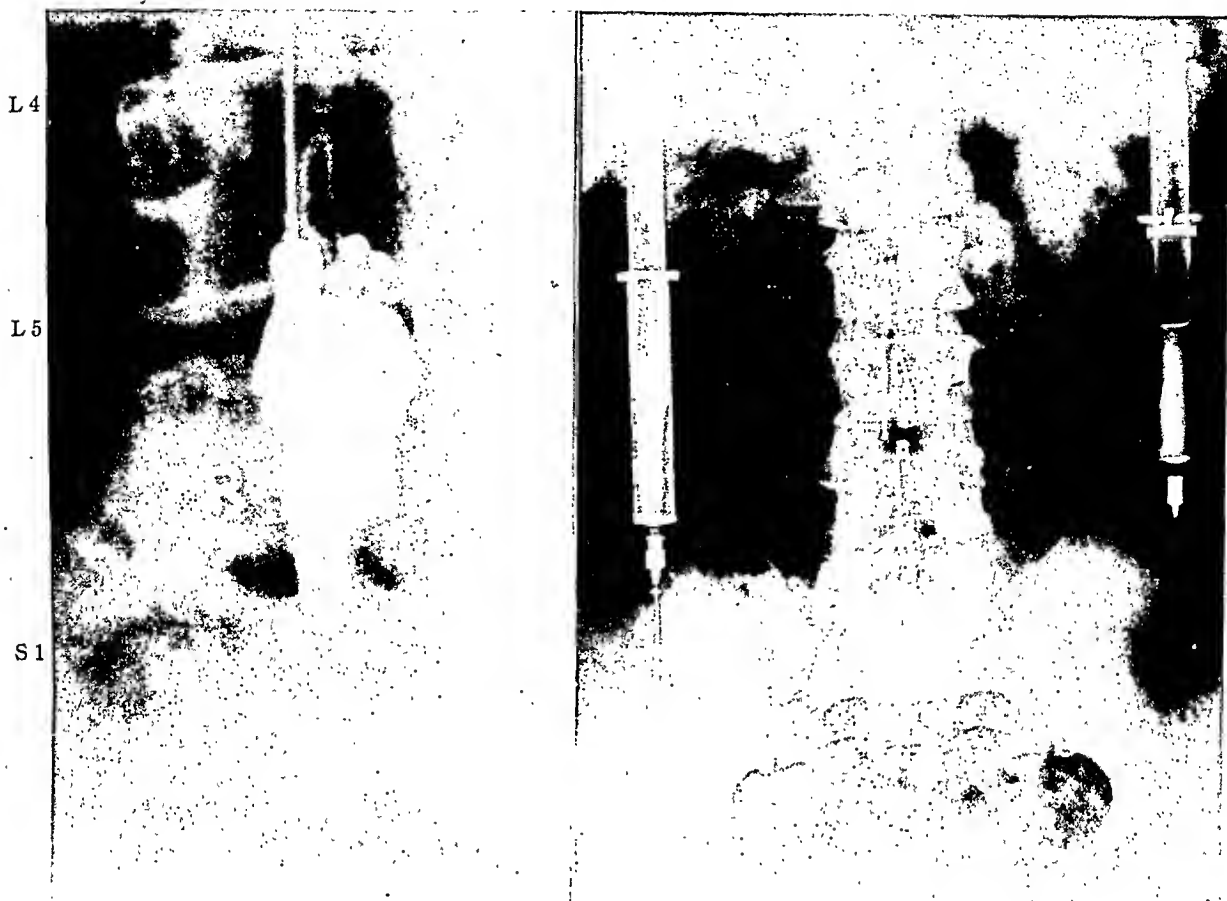
Fig. 6. Myelography can be used to rule out protruded disks in patients with sciatic pain before they are submitted to orthopedic surgery.

CASE 6: O. J. M., seaman, second class, age 35, had for two months experienced a knife-like pain radiating down the back of the right leg from the hip. Sneezing or coughing aggravated the pain. Walking or work also produced it. There were periods of complete freedom when the patient was lying down or was not required to work. Neurological examination was negative. Routine radiographic examination revealed a lumbarization of the sacrum on the left, which is a common congenital anomaly. It probably bore no relationship to the back pain. Myelography was negative. The patient was transferred to the orthopedic service for spinal fusion because of incapacitating pain.

men, or surgical skill. We do not believe that it is necessary to do myelographic examination in cases that are definite and clear cut. One neurological surgeon (3) estimates that this group constitutes about 60 per cent of the patients with intraspinal protrusions of the lumbar disks. Even at this time, however, the clinical signs of intraspinal disk protrusion are not always so characteristic as to warrant operation without objective and confirmatory myelographic evidence. Myelography then should be used in much the same way as radiographic examination with other contrast media, such as ventriculography,

bronchography, pyelography, cholecystography, etc. In other words, if the indications for operation are so convincing that the surgeon can assume full responsibility for the accuracy of his findings, myelography is not necessary. On the other hand, many men prefer some support from an objective examination before submitting their patients to major surgery. At the present time we feel that there is a practical method for myelographic examinations, although the future will undoubtedly bring greater refinements and newer contrast media (Figs. 3-6).

Another indication for myelography is in



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After Removal

Fig. 7. Persistence or recurrence of pain after an operation for the removal of a disk is an indication for myelography to detect a recurrence or an incomplete removal of the disk. By contrast myelography in such instances, it is usually possible to determine if the disk was completely removed, if it recurred, or if another disk has protruded. It is even more important to do a myelographic examination if none has been previously performed.

CASE 8: R. B., Marine sergeant, age 28, had been operated on elsewhere in November 1942, with an interlaminar removal of a ruptured disk between the fifth lumbar vertebra and the sacrum. His symptoms were somewhat improved for a time but recurred. He complained of low back pain which radiated down the left leg. The left ankle jerk was absent and hypesthesia was present over the lateral aspect of the left leg. Myelographic examination with Pantopaque revealed a defect at the fifth disk on the left, with obliteration of the axillary sheath. At the second operation the remainder of the disk was found and removed. The symptoms gradually subsided and the patient returned to active duty.

the examination of patients who have a persistence or a recurrence of back pain following an operation for a protruded disk. In these cases myelography is of value to determine if the pain is due to incomplete removal of the operated disk, to a recurrence, or protrusion of another disk at a different level (Fig. 7).

Similarly, a myelographic examination is of value to demonstrate negative or normal disks in patients with recurrence or persistence of pain after an operation for a protruded disk. Objective radiographic evidence will greatly aid in the subsequent

treatment and disposition of these patients. This is particularly true in the handling of industrial cases, as well as those in the Armed Services (Fig. 8).

Myelography is also helpful in the positive identification of multiple protruded disks and gives the surgeon aid in localizing the herniated disks and in sparing many patients unnecessary exploration of normal disks (Fig. 9).

SUMMARY AND CONCLUSIONS

1. Pantopaque is a satisfactory contrast medium for spinal myelography.



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Fig. 8. Myelography is of value to demonstrate negative or normal disks in patients with recurrence or persistence of pain after an operation for a disk. This is particularly important in industrial and military practice, where the patient may wish to prolong or exaggerate his pain and degree of disability.

CASE 8: E. S. T., Marine corporal, age 34, began in April 1943 to complain of low back pain which radiated down the left leg. The pain gradually increased in frequency and intensity. It was aggravated by sneezing and coughing. Various types of treatment were given without permanent relief. Neurological examination revealed a hypesthesia over the lateral aspect of the left leg and the base of the great toe. The diagnosis of a ruptured disk between the fifth lumbar vertebra and the sacrum on the left was made. On Jan. 21, 1943, the ruptured disk was removed by the interlaminar method. The patient's condition improved and he was returned to active duty on April 21, 1943. He was readmitted on May 29, 1943, complaining of backache and slight leg pain. Myelography with Pantopaque was negative, and all the oil was easily removed without discomfort. With this information plus the knowledge that there were no postoperative complications, it was possible to transfer the patient to the orthopedic service for a few manipulative and physical therapy treatments, which were followed by prompt return to duty.

In our experience, it is the most satisfactory one to date. It seems to produce no unfavorable reactions and is removed from the spinal canal without difficulty.

2. A new procedure is described for the removal of Pantopaque after completion of the radiographic examination, by methods designed to increase the intraspinal pressure rather than by use of a syringe with positive suction. By this means it has been possible to remove all but a few drops of the oil, without pain to the patient.

3. The value and use of myelographic

examinations are discussed and cases are presented to illustrate the indications both before and after operative procedures for protruded disks.

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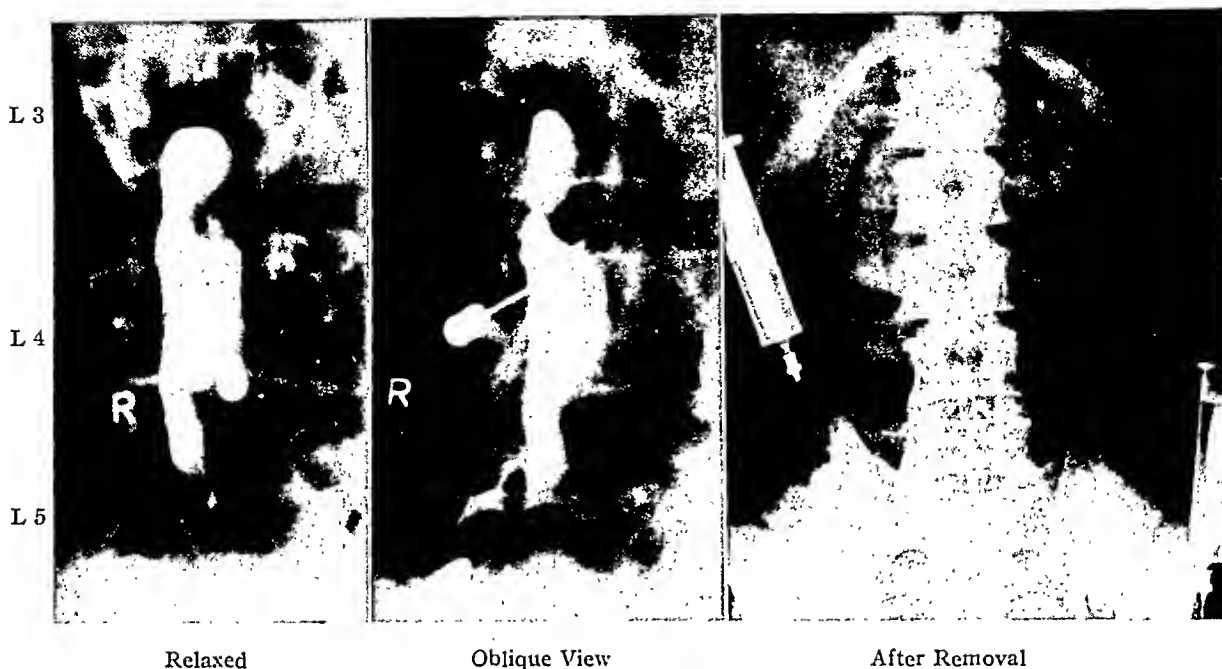


Fig. 9. Myelography is of value in the recognition of multiple protruded disks or other lesions. The detection of multiple protruded disks makes it possible for the surgeon to know just what disks must be examined and removed. Likewise, the finding of normal disks by myelography and the accurate visualization of the protruded disk eliminate needless exploration of normal disks.

CASE 7: D. L. H., carpenter's mate, third class, age 41, experienced a gradual onset of pain in the back and down the left leg five months before admission. Pain was aggravated by coughing and sneezing. Orthopedic measures gave no relief. The left ankle jerk was reduced and hypesthesia was found along the lateral aspect of the left leg from the knee to the ankle. Following operation for the removal of the disk, symptoms disappeared.

The large defect between the third and fourth lumbar vertebrae was originally thought to be due to a disk, but at operation was found to be the result of large veins. The lower defect proved to be a protruded disk.

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Radiation Therapy of Lymphoid Tissue in the Nasopharynx and Pharynx

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DURING THE FIVE-YEAR interval between 1939 and 1943 inclusive, 157 patients were treated with roentgen rays and/or gamma rays for the removal of lymphoid tissue in the nasopharynx and pharynx. Of these patients, 86 (55 per cent) were males and 71 (45 per cent) females. The greatest incidence occurred in the first decade, with an even spread in middle age and a rapid decline above the fifth decade. Approximately one-third of the patients were less than fifteen. The youngest was nine months; the oldest, seventy-eight years. The distribution of cases was as follows: up to nine years of age, 44 (28 per cent); ten to nineteen years, 24 (15.2 per cent); twenty to twenty-nine, 29 (18.6 per cent); thirty to thirty-nine, 25 (15.9 per cent); forty to forty-nine, 19 (12.1 per cent); fifty to fifty-nine, 10 (6.3 per cent); sixty to sixty-nine, 4 (2.5 per cent); seventy to seventy-nine, 2 (1.2 per cent).

Symptoms fell into three main classes. In the group of 27 cases (17 per cent of the series) which presented demonstrable hearing losses, audiograms were obtained whenever possible. Fifty-one patients (32 per cent) had lymphoid masses large enough to obstruct respiration, as was evidenced by mouth breathing. Almost all of the patients (144, or 92 per cent) had some form of upper respiratory infection, such as pharyngitis, otitis media, sinusitis, tonsillitis, etc. In this group, 13 of the children had acute cervical adenitis; 8 had otitis media; 3 had acute rheumatic fever; 4 had asthma.

The amount of lymphoid tissue present was classified on an arbitrary basis from one to four plus. One plus represents a minimal amount of tissue, usually in the

form of small flecks over the mucous membranes. Two plus represents a more noticeable amount, but not sufficient to cause obstruction; three plus means sufficient lymphoid tissue to cause mouth breathing. Four plus is reserved for those cases where the tonsils meet in the mid-line or where the nasopharynx is so choked with adenoids that little, if any, air space remains. Sixteen cases, or 10 per cent, were classified one plus; 90, or 57 per cent, two plus; 36, or 23 per cent, three plus; the remaining 15 (10 per cent) fell in the four plus group.

The first cases in this series were treated with extremely conservative amounts of radiation, as it is believed that in the treatment of benign conditions there is seldom justification for the production of erythemas or other permanent radiation side effects. Aside from temporary dryness of mouth, which is an occasional minor complaint, no such effects have been noted. By proceeding slowly and cautiously, it was found that the average patient could tolerate without untoward effects 800 to 1,200 tissue roentgens, administered to the nasopharynx and pharynx within a period of four to five weeks. The dosages employed are shown in Table I. The results obtained were good. This dosage was very satisfactory for young children; but in older children and adults, it did not always completely clean out the lymphoid tissue from the nasopharynx.

Hence, an applicator was devised by means of which 25 mg. of adequately filtered (1.0 mm. platinum) radium could be introduced into the nasopharynx through each naris. By leaving the radium in place for one and one-half hours, a dose of 75 mg. hr. is delivered, and this has been selected as standard dosage in almost all cases. No unfavorable reaction has been produced by this proce-

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

TABLE I: ROENTGEN DOSAGE IN CASES NOT RECEIVING GAMMA RADIATION

Tissue Roentgens	Cases
0- 99.....	0
100- 199.....	0
200- 299.....	5 (5.1%)
300- 399.....	3 (3.0%)
400- 499.....	3 (3.0%)
500- 599.....	4 (4.0%)
600- 699.....	4 (4.0%)
700- 799.....	1 (1.0%)
800- 899.....	15 (15.3%)
900- 999.....	17 (17.3%)
1000-1099.....	15 (15.3%)
1100-1199.....	17 (17.3%)
1200-1299.....	4 (4.0%)
1300-1399.....	5 (5.1%)
1400-1499.....	1 (1.0%)
1500-1599.....	0
1600-1699.....	2 (2.0%)
1700-1799.....	0
1800-1899.....	1 (1.0%)
1900-2000.....	1 (1.0%)
TOTAL.....	98

cedure, and it has been possible with this supplementary radiation to reduce the roentgen tissue dosage and obtain a superior end-result. The cases treated by the combination of roentgen and gamma rays are tabulated in Table II, where it is seen that only 8 out of 62 cases required over 1,000 tissue roentgens.

From these studies the following basic procedure has been evolved: Within a period of twenty-nine days, the patient receives three pairs of roentgen-ray treatments, a radium treatment, and two more pairs of roentgen-ray treatments. Two treatments are given in the first week, and the remaining ones are administered at weekly intervals. In other words, the patient receives x-ray treatments on the first, fourth, eighth, twenty-second and twenty-ninth days and a radium application on the fifteenth day. The physical factors employed are 200 kv.p., 60 cm. target-skin distance, 0.5 mm. copper filter, 10 cm. diameter round cone, 125 r (as measured in air) to each of two ports, one on each side of the face and neck. In selecting the ports, the central beam is directed perpendicularly to the sagittal plane of the head with the upper edge of the treatment cone tangent at the external auditory canal to an imaginary horizontal plane passing through the canal. The radium

treatment, as previously noted, consists of 75 mg. hr. in the nasopharynx. Figure 1 is a typical therapy chart. When more roentgen therapy is required than is delivered by this basic technic, the additional radiation should be administered perorally, rather than by increasing the dosage through the lateral ports which

TABLE II: ROENTGEN DOSAGE IN CASES RECEIVING GAMMA RADIATION*

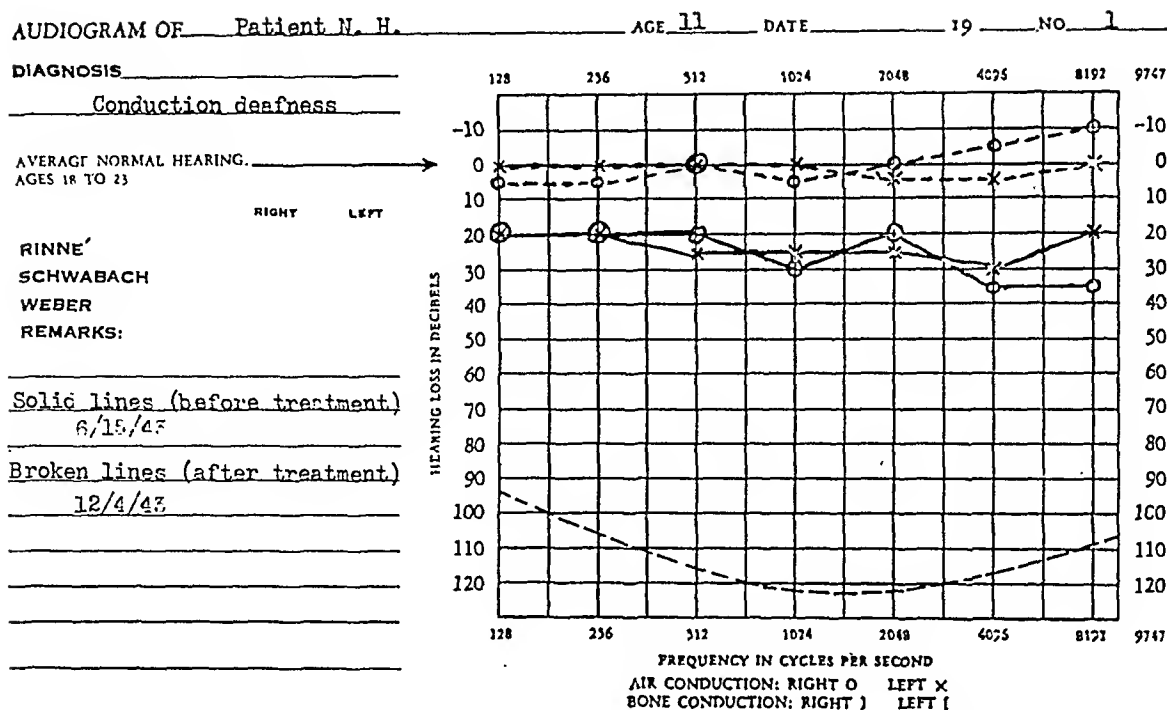
Tissue Roentgens	Cases
0- 99.....	2 (3.2%)
100- 199.....	0
200- 299.....	1 (1.6%)
300- 399.....	0
400- 499.....	0
500- 599.....	2 (3.2%)
600- 699.....	3 (4.8%)
700- 799.....	2 (3.2%)
800- 899.....	32 (51.6%)
900- 999.....	12 (19.3%)
1000-1099.....	3 (4.8%)
1100-1199.....	1 (1.6%)
1200-1299.....	1 (1.6%)
1300-1399.....	1 (1.6%)
1400-1499.....	1 (1.6%)
1500-1599.....	0
1600-1699.....	0
1700-1799.....	0
1800-1899.....	0
1900-2000.....	1 (1.6%)
TOTAL.....	62

* The discrepancy in the number of cases listed in Tables I and II (160 rather than 157) is due to the fact that 3 cases were retreated.

have been described. A dose of 1,000 skin roentgens (back-scatter included) is considered the safe upper limit for any single port.

During the course of this work, numerous impressions have been formed. These impressions we believe will be confirmed with further experience. The gratifying results obtained in the treatment of conduction deafness in children are outstanding. Two illustrative cases follow:

CASE I: N. H., white male, aged eleven years, was referred by Dr. S. L. Fox on June 19, 1943. The tonsils had been removed previously. Both eustachian orifices were completely obliterated by lymphoid tissue, which extended down the posterior pharyngeal wall. The patient showed considerable hearing loss, as was demonstrated on the audiogram of June 15. Between June 19 and Aug. 23 (sixty-six days) the patient received 1,920 tissue roentgens, and on July 13 he received 75 mg. hr. of radium. By the middle of September, hearing was relatively



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Fig. 2. Case I: Audiograms before and after treatment

cient cardiac disease to contraindicate surgery. Results to date have been satisfactory. It has been observed that, as a general rule, lymphoid tissue becomes less radio-sensitive with age, and also less sensitive in the presence of prolonged suppurative infection. In such cases larger doses must be given to obtain satisfactory results. For this reason, cases presented for treatment should have a careful examination, including nasopharyngoscopy, to determine those most suitable for the method of treatment described. If such care is exercised, the results will leave little to be desired. The full effect of the irradiation is

not ordinarily noted until from six to eight weeks after the final treatment. This period may be shorter in the case of young children and longer in the case of adults with chronically infected lesions.

SUMMARY

Over a five-year period, 157 patients were treated with radiation for lymphoid tissue in the nasopharynx and pharynx. The procedure is believed to be practical, efficacious, and efficient.

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A Quantitative Study of the Effect of Temperature on Sensitivities of X-Ray Screens and Films¹

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IT IS WELL KNOWN that the brilliance of fluorescent screens and the speed or sensitivity of radiographic films are affected by changes in temperature. Although these phenomena have been of little more than academic interest in the past, they have recently assumed new importance because of the varied climatic conditions

esce most brilliantly at about -100°C . At room-temperature (25°C .) their emission is approximately 35 per cent less than maximum and diminishes steadily as temperature is increased. The temperature of maximum brilliance for zinc sulfide (fluorazure and photoroentgen) and for zinc cadmium sulfide (type "B" fluoroscopic)

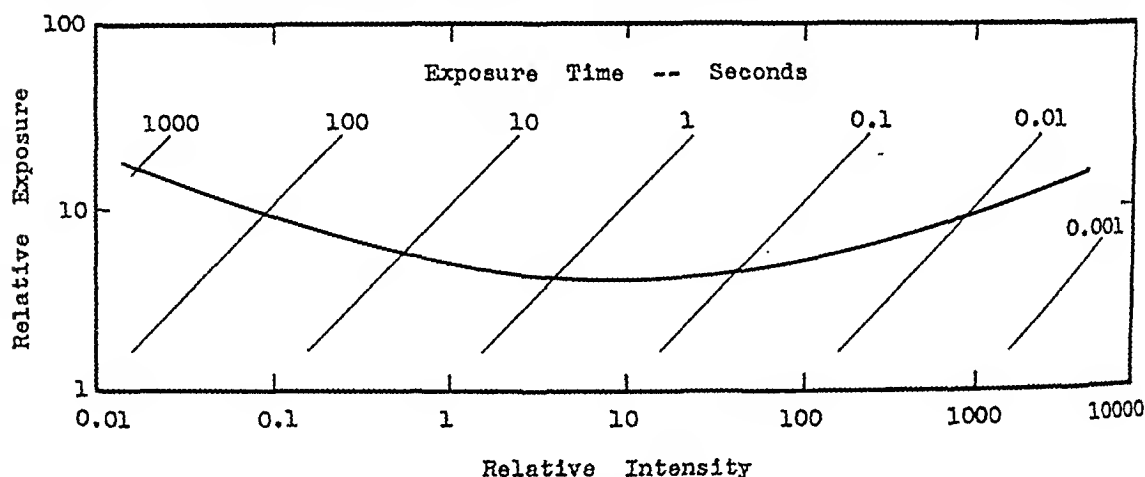


Fig. 1. Relative quantity of radiation (exposure) required to produce a density of 1.0 in a typical photographic film at various levels of intensity. Diagonals indicate the exposure times which were employed at the various levels of intensity.

under which radiological examinations are conducted in the military services.

The relationship between temperature and the brilliance of a fluorescent material is relatively simple (1, 2). At very low temperatures fluorescent emission is low but it rises rapidly as temperature increases and reaches a maximum at a point depending upon the chemical composition of the material. Beyond this point the emission gradually decreases and falls again to very low levels at high temperatures. Calcium tungstate screens fluor-

screens is at or near room-temperature. The emission of these materials changes only slightly when temperature is increased or decreased as much as 100°C .

The effect of temperature on the speed or sensitivity of radiographic films is dependent on the method of exposure. Films exposed with roentgen rays directly exhibit a slow rise in sensitivity as temperature increases (3). The behavior of films exposed with intensifying screens is more complex. Since almost all of the blackening produced in films exposed in this manner is the result of fluorescent radiation lying within the visible spectrum, such films react to temperature in much the same way as photographic materials. Webb (4) has shown that this reaction is closely related to the phenomenon of reciprocity law failure.

¹ From the Division of Roentgenology, University of Chicago. The work described in this paper was done under a contract recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the University of Chicago. The paper was read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

The reciprocity law states, among other things, that a particular quantity of radiation always produces the same photographic effect regardless of the intensity² of the exposing radiation. It long has been recognized that photographic films do not in general fulfill this law, and it has recently been shown that the law is also violated by radiographic films exposed with intensifying screens (5). Relatively large quantities of radiation are required to produce a given photographic or radiographic effect when the intensity of the exposing radiation is low. As intensity increases,

1.0 (approximately the average density of a correctly exposed film) in a typical photographic emulsion at various levels of intensity is shown in Figure 1. Such a curve is usually referred to as a reciprocity-law-failure curve. The exposure times corresponding to the various intensity levels are indicated by the diagonals.

Webb (4) has observed that changes in temperature cause a shift in the reciprocity-law-failure curve of a film in the direction of the intensity-axis. Increasing temperature effects a shift to the right, whereas decreasing temperature causes a shift to the

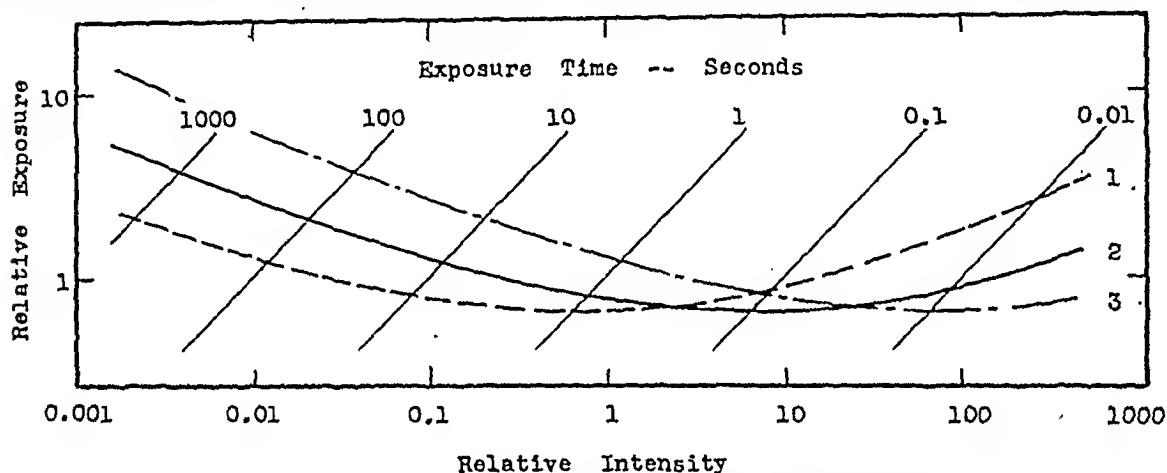


Fig. 2. Relative exposures required to produce a density of 1.0 in a typical radiographic film exposed with intensifying screens at various levels of intensity. Curve 1 was prepared from data made at -10°C . Curves 2 and 3 correspond to temperature levels of 25° and 60°C ., respectively.

the amount of radiation required decreases and reaches a minimum near the intensity level commonly employed in general radiography. When intensity is increased still further, the necessary quantity of radiation increases and rises again to high values at high intensity levels. A curve illustrating the relative quantities of radiation required to produce a film-density of

left. These observations are illustrated in Figure 2, where the quantities of radiation required to produce a film-density of 1.0 in a typical radiographic film exposed with intensifying screens are plotted through a wide range of intensity at three temperature levels.

The speed or sensitivity of a radiographic film may best be expressed as the reciprocal of the quantity of radiation (exposure³) required to produce a film-density of 1.0; that is,

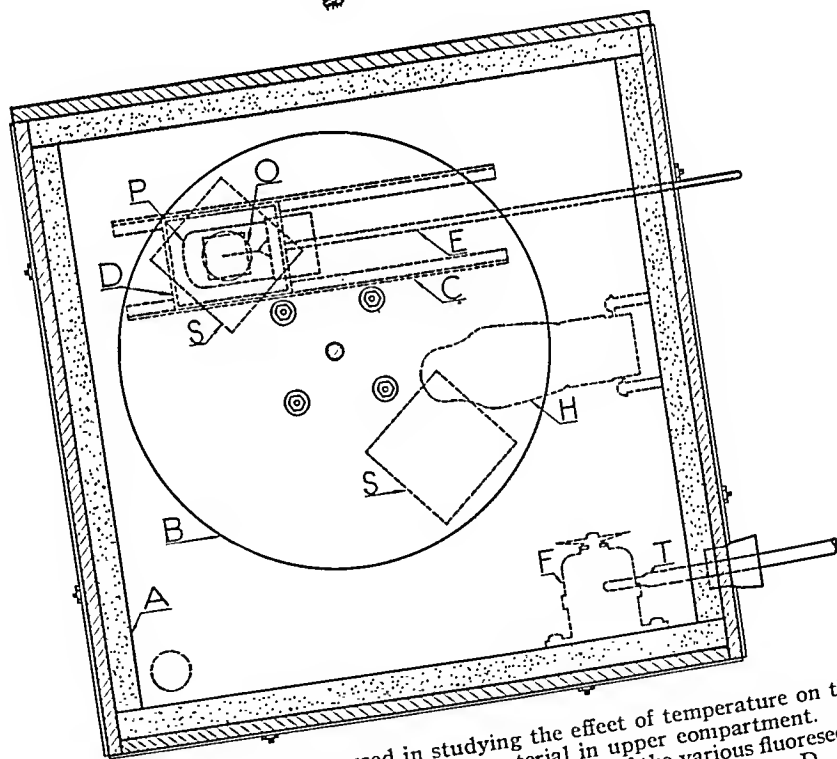
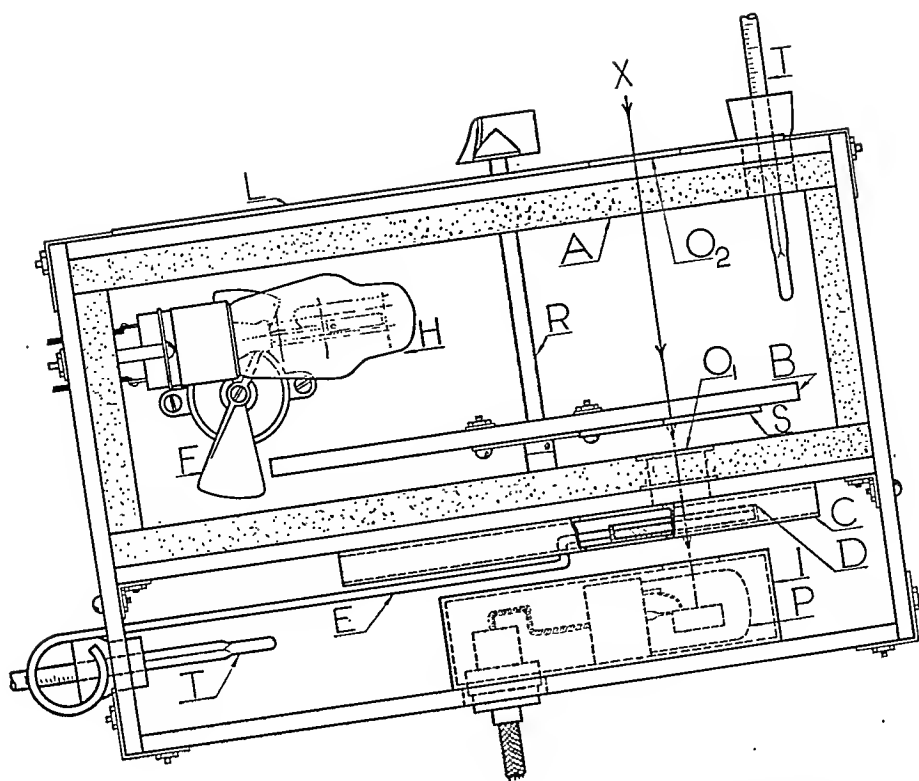
$$s_e = \frac{d}{E_{1.0}} \quad (1)$$

where s_e is the speed of the film, $E_{1.0}$ is

³ The terms, quantity of radiation and exposure, have precisely the same meaning.

² The term, intensity, has been frequently misused in the radiological literature to denote the quantity of radiation received by a film during its exposure; consequently many radiologists are unfamiliar with its correct meaning. Stated simply, intensity refers to the brightness of the exposing radiation, or more strictly to the time-rate at which radiant energy is applied to a film.

The relationship between the terms quantity of radiation and intensity of radiation is clearly expressed by the equation, Quantity = Intensity \times Exposure Time. Thus, it is evident that, although the two terms are closely related, they must not be used interchangeably.



Figs. 3 and 4. Thermal chamber used in studying the effect of temperature on the brilliance of fluorescent screens. A. Insulating material in upper compartment. B. Turntable on the undersurface of which were mounted standard fluorescent screens, S, which were studied. C. Track carrying standard fluorescent screen, D. E. Lever with which standard fluorescent screen was moved. F. Circulating fan. H. Electric heating element. I. Photoelectric intensitometer, including the phototube, P. L. Lead plate including the aperture, O_2 . O_1 . Aperture in floor of upper compartment. R. Rotor of turntable, B. T. Thermometers. X. Pathway of x-ray beam (solid line) and pathway of fluorescent light (dotted line).

the exposure required to produce a film-density of 1.0, and d is an arbitrary constant of such magnitude that the various values of s_e fall within a convenient range of numbers.

An analysis of the curves shown in Figure 2 reveals that, when films are exposed at high levels of intensity, an increase in temperature causes an increase in film-speed, whereas at low intensity levels the effect is just the reverse. Between these extremes the effect of temperature may be first in one direction and then in the other.

In view of this complex relationship, it is not surprising that, prior to Webb's observations, the published data on the thermal reaction of photosensitive materials seemed inconsistent. Stumpf (6), in an investigation conducted almost twenty years ago, found that the speed or sensitivity of radiographic films increases and the brilliance of intensifying screens decreases as temperature increases. He concluded that the effects balance one another, and that for all practical purposes films exposed with intensifying screens are unaffected by temperature. In contrast to these observations, Eggert and Luft (3), and Wilsey (7) report that film-sensitivity falls off sharply as temperature rises. From what is now known, it is apparent that Stumpf's observations were conducted at high levels of intensity, whereas those made by Eggert and Luft and by Wilsey were conducted at relatively low intensity levels.

QUANTITATIVE RELATIONSHIP BETWEEN TEMPERATURE AND THE SENSITIVITIES OF RADIOGRAPHIC MATERIALS

During the past few months a comprehensive quantitative study of the influence of temperature on the behavior of radiographic materials has been conducted in this laboratory. The investigation embraced three phases: (1) the examination of various fluorescent screens; (2) the examination of radiographic films exposed with intensifying screens; (3) the examination of radiographic films exposed with x-rays directly.

(1) *Fluorescent Screens:* To study the influence of temperature on the brilliance of fluorescent screens the thermal chamber illustrated in Figures 3 and 4 was constructed. The chamber's upper compartment insulated with Masonite presdwood, included the turntable, B , the electric heating element, H , the circulating fan, F , and the thermometer, T . The compartment was covered by the lead plate, L , having the aperture, O_2 , 1.5 inches in diameter. Perpendicularly below O_2 , in the floor of the compartment, was another aperture, O_1 . The latter opening, sealed with glass to prevent the transmission of heat, permitted light to pass to the lower compartment.

The lower compartment included the radiation detector, I , of a photoelectric intensitometer, the thermometer, T , and the standardizing fluorescent screen, D . The phototube, P , of the intensitometer was located directly beneath the aperture, O_1 , and the standardizing screen, D , mounted in the track, C , could be moved over the phototube by means of the lever, E .

Samples, 2 inches square, of the various fluorescent screens to be tested were mounted peripherally on the undersurface of the turntable, B (see Fig. 4). The upper compartment of the thermal chamber was then refrigerated to -10°C ., and after establishment of equilibrium temperature conditions an x-ray beam was projected through the chamber along the pathway, X , causing the fluorescent screen below the aperture, O_2 , to fluoresce. The intensity of the radiation emitted by the screen was recorded by the intensitometer, I . By rotating the turntable, the remaining screens were brought into the x-ray beam and their brilliance was measured. The procedure was repeated at temperatures ranging to 60°C ., the heating element, H , providing the desired rise in temperature. From time to time during the investigation readings of the emission of the standardizing fluorescent screen, D , were made. It was thus possible to maintain the intensity of the x-ray beam constant while the study was in progress.

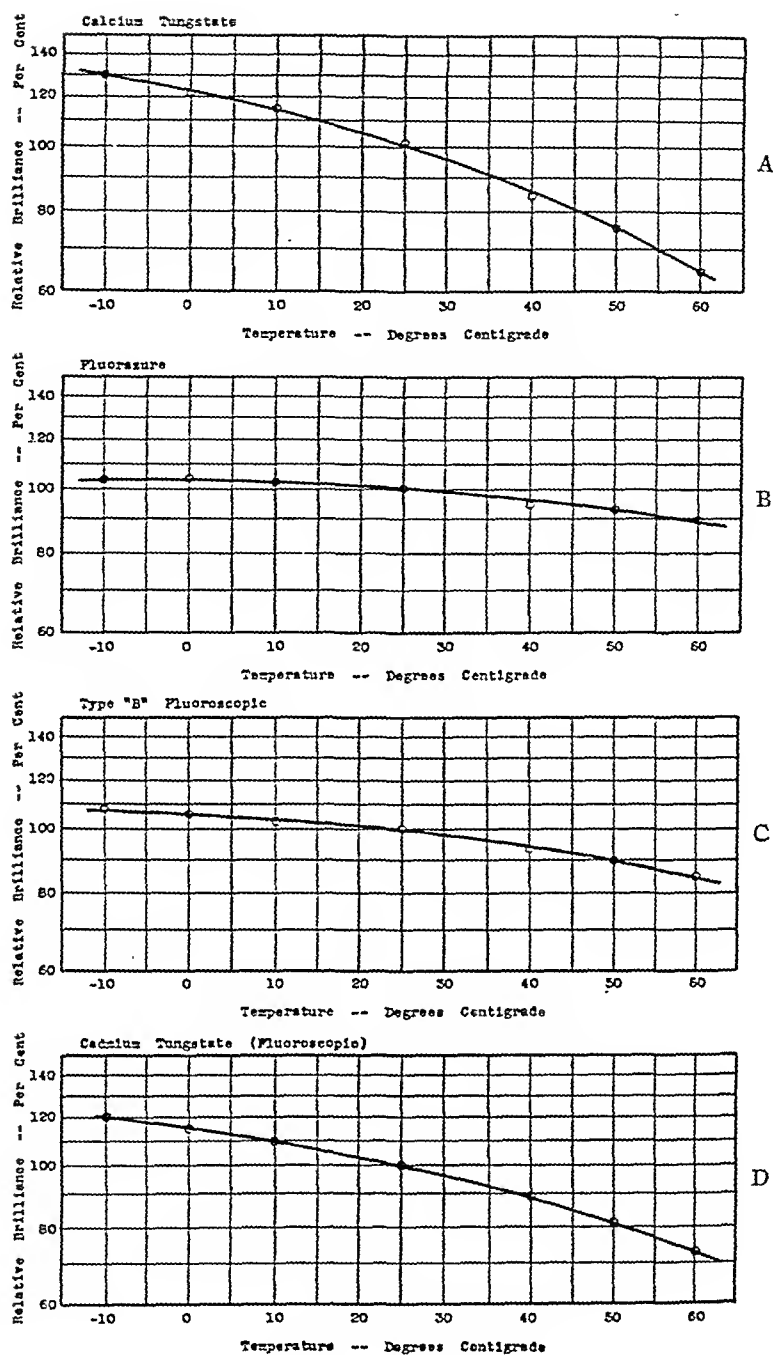


Fig. 5. Relative brilliance of various fluorescent screens through a range of temperature extending from -10 to 60°C . A. Calcium tungstate intensifying screens. B. Fluorazure and photoroentgen screens. C. Type "B" fluoroscopic screen. D. Cadmium tungstate (fluoroscopic) screen.

Type "B" fluoroscopic, fluorazure, photoroentgen, cadmium tungstate (fluoroscopic), and nine brands of calcium tungstate intensifying screens were examined. The results of the study are illustrated in Figure 5, where the relative brilliance of

the several materials is plotted through a range of temperature extending from -10°C . to 60°C . In each case the temperature of 25°C . indicates a relative brilliance of 100 per cent. The nine brands of calcium tungstate intensifying screens behaved al-

most identically and for practical purposes can be represented by the single curve shown in Figure 5A. It will be observed that at 0° C. these screens have a brilliance approximately 25 per cent greater than that occurring at room-temperature, whereas at 50° C. their brilliance is approximately 25 per cent less. The characteristics of fluorazure and photo-roentgen screens are shown in Figure 5B. As previously mentioned, these materials exhibit relatively little change in brilliance as temperature is varied from -10° C. to 60° C. The same is also true of the type "B" fluoroscopic screen (Fig. 5C). Figure 5D illustrates the characteristics of the now obsolete cadmium tungstate (fluoroscopic) screen. It will be observed that these are similar to those of calcium tungstate intensifying screens.

(2) *Radiographic Films Exposed with Intensifying Screens:* The thermal chamber illustrated in Figures 3 and 4 was also used to study the influence of temperature on the sensitivity of radiographic films exposed with intensifying screens, the turntable, *B*, being replaced by a cassette which included a pair of calcium tungstate intensifying screens and strips of the various films to be tested. The sensitometric procedure which was followed was the aluminum-ladder method of White (8) and was conducted at temperatures ranging from -5° C. to 55° C., and at intensity levels ranging from that which produced a film-density of approximately 2.0 at an exposure time of 1/120 of a second to that which produced a similar degree of blackening at an exposure time of 1,000 seconds. The radiation with which the various exposures were made was provided by a full-wave valve-rectified machine, and the exposures received by the films were recorded by a photoelectric roentgen-ray intensitometer (9) operating as an integrating device and having a quality response identical to that of the various film-screen combinations. The intensity of the exposing radiation was varied by changing the target-film distance, the voltage of the roentgen tube, and by placing aluminum filtration in the

roentgen beam. In no exposure, however, did the half-value layer of the radiation vary more than 10 per cent from a value of 1.0 mm. of aluminum. It was considered desirable to maintain the quality of the radiation constant within these limits in order that the contribution to film-blackening by the front and back intensifying screens be uniform throughout the investigation. Thus the sensitometric data were not influenced by the quality of the exposing radiation.

Four commercial brands of radiographic film were examined. The results of the investigation are illustrated graphically in Figure 6, where the exposures required to produce a film-density of 1.0 are plotted through a wide range of intensity at three levels of temperature. As in Figures 1 and 2, the diagonals indicate the exposure times which correspond to the various intensity levels. The abscissae refer to the intensity of the radiation emitted by the fluorescent intensifying screens rather than that of the x-radiation. Thus Figure 6 indicates the effect of temperature on the behavior of the films themselves and not on the behavior of the film-screen combinations.

Figure 7 illustrates the relative speeds of the four brands of film plotted through a range of temperature extending from -5° C. to 55° C. at three intensity levels. These data were calculated from Figure 6 by means of equation (1).

The range of intensity employed in general radiography corresponds to that extending from a relative intensity of 0.1 to a relative intensity of 10 (Figs. 6 and 7). The intensity at which lateral lumbar spines are filmed is of the order of 0.1; that is, the intensity of the radiation reaching the film under these circumstances is usually low. The intensity of the radiation at which chest examinations are usually performed corresponds to a relative intensity of approximately 10. Other radiographic procedures fall between these two limits in most cases.

It will be observed that, at intensity levels at which chest examinations are conducted (curve 3, Fig. 7), the effect of

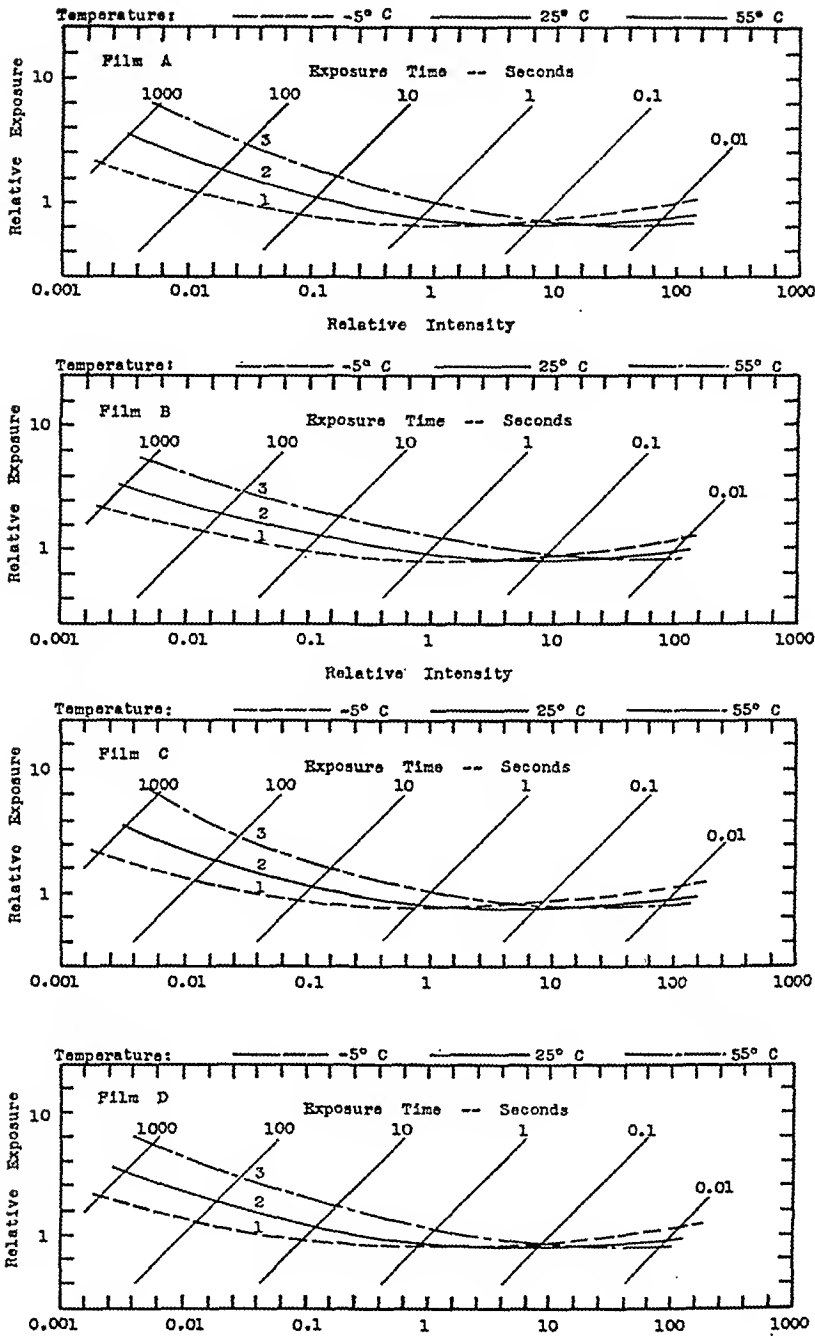


Fig. 6. Relative exposures required to produce a density of 1.0 in four commercial brands of radiographic film exposed with light (from calcium tungstate intensifying screens) at various levels of intensity. Curve 1. -5°C . Curve 2. 25°C . Curve 3. 55°C .

temperature on film speed is small. At intensity levels corresponding to those at which lateral lumbar spine filming is conducted, however (curve 1, Fig. 7), the effect of temperature is relatively great; indeed, some films exhibit a 65 per cent drop in sensitivity as temperature rises from -10°C . to 60°C . The effect of tem-

perature on film-speed at intensity levels corresponding to those at which the bulk of radiographic examinations (relative intensity of 1.0) are conducted is somewhat less than that at the very low intensity levels.

The combined effects of temperature on the brilliance of calcium tungstate intensi-

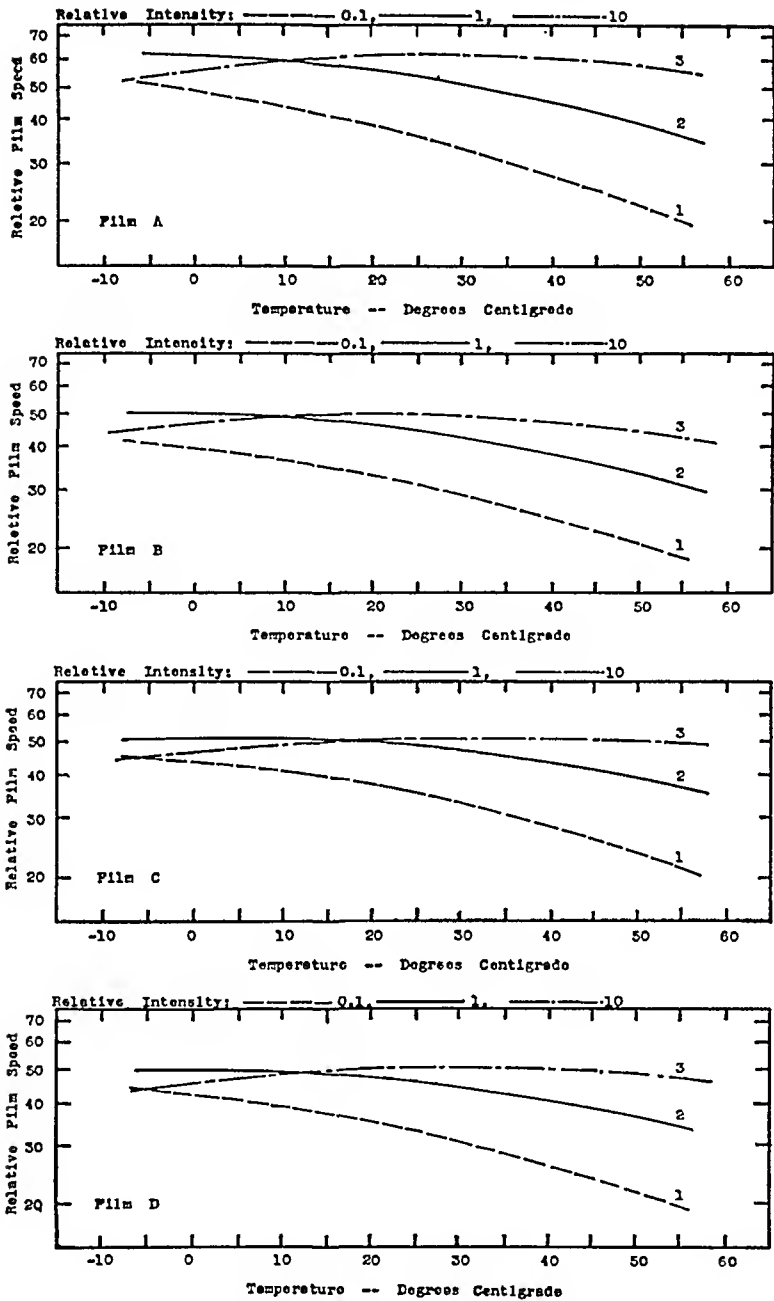


Fig. 7. Effect of temperature on the relative speeds of four commercial brands of radiographic film exposed with light (from calcium tungstate intensifying screens). Curve 1. Exposures made at relative intensity of 0.1 (conditions encountered when filming lateral lumbar spine). Curve 2. Exposures made at relative intensity of 1.0 (most radiographic procedures are conducted at or near this intensity level). Curve 3. Exposures made at relative intensity of 10 (radiography of the chest is conducted at or near this intensity level).

fying screens and on the speed of radiographic film are shown in Figure 8. Here are plotted the relative exposures required to produce a film-density of 1.0 (average density of a correctly exposed roentgenogram) in each of the four brands of film

whose characteristics are shown in Figures 6 and 7, when exposed with calcium tungstate intensifying screens at temperatures ranging from -10°C. to 60°C. As before, curves 1, 2, and 3 indicate the required exposures when the intensity levels.

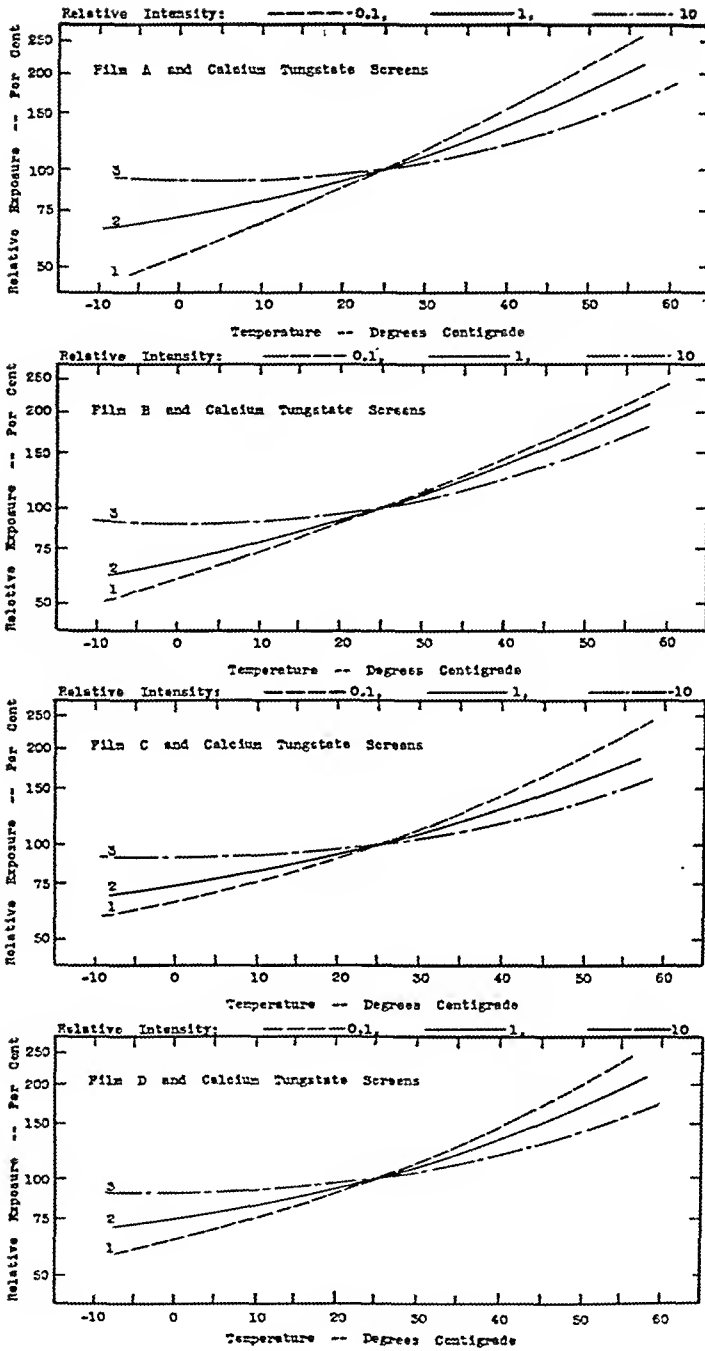


Fig. 8. Relative exposures required to produce correctly exposed roentgenograms at various temperature levels compared to that required at 25° C. Curve 1. Exposures made at relative intensity of 0.1 (lateral lumbar spine filming). Curve 2. Exposures made at relative intensity of 1.0 (most radiographic examinations are conducted at or near this intensity level). Curve 3. Exposures made at relative intensity of 10 (chest radiography). These curves apply only to films exposed with calcium tungstate intensifying screens.

are 0.1, 1.0 and 10, respectively. Each curve has been plotted on the basis that 100 per cent exposure is required at a temperature of 25° C. These curves, therefore, do not provide a means for comparing

the relative sensitivities of the various film-screen combinations, nor the relative sensitivities of a single combination at various intensity levels. Such data can be calculated from Figures 5 and 7. In most

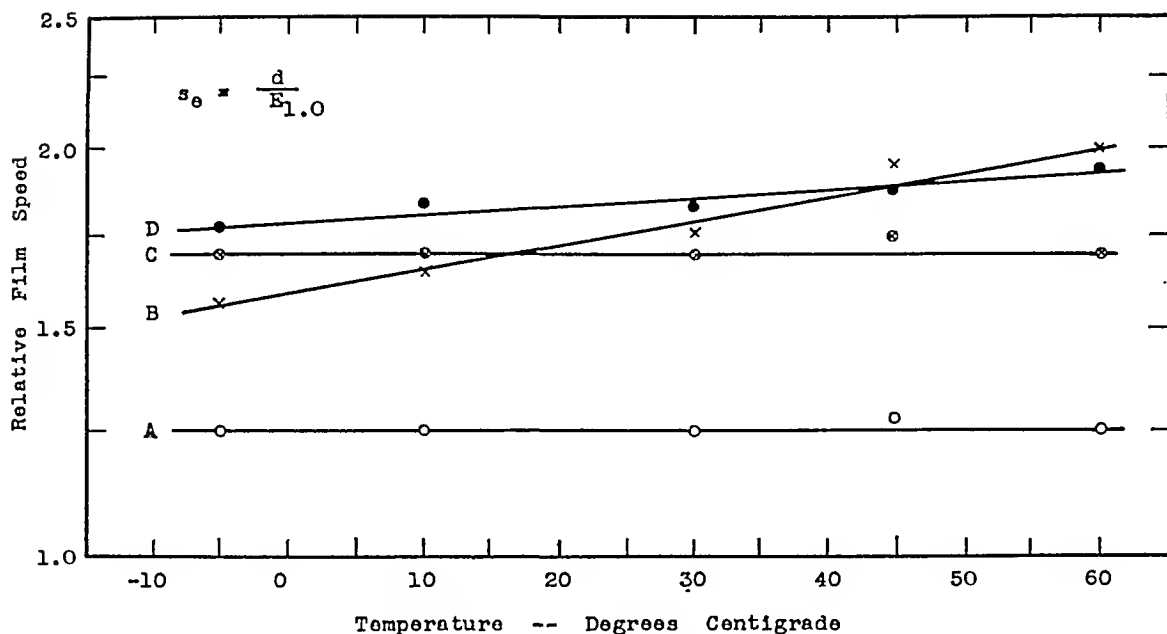


Fig. 9. Effect of temperature on the relative film-speeds of four commercial brands of radiographic film exposed with x-rays directly.

cases, however, the radiologist who is seeking information regarding the effect of temperature on the speed of a radiographic film is interested only in knowing the amount of exposure which is necessary at the temperature at which he is working relative to that which is required under normal operating conditions (e.g., room-temperatures). The curves in Figure 8 provide such information.

At the levels of intensity used in chest radiography (curve 3) the effect of temperature on the sensitivities of the various film-screen combinations is negligible below 25° C. Above room-temperature, the amount of radiation required to produce a given radiographic effect rises slowly until at 60° C. the necessary exposure is between 50 and 100 per cent greater than that at room-temperature. At intensity levels corresponding to those at which the bulk of radiographic examinations are conducted, the effect of temperature on the speed of the film-screen combinations is such that almost three times as much radiation is required at 60° C. as at -10° C. At low levels of intensity (conditions at which lateral lumbar spine films are made), the effect of temperature is even more marked.

Here approximately five times as much radiation is necessary to produce a particular radiographic effect at 60° C. as at -10° C.

Within the usual range of room-temperature (20 to 35° C.), radiographic films exposed with intensifying screens exhibit little change in sensitivity under most circumstances. When the intensity of the radiation falling on the radiographic film is low, requiring exposure times in excess of five seconds, however, almost 70 per cent more radiation is required at 35° C. than at 20° C. Thus the effect of temperature becomes important when raying heavy structures or when using low-powered radiographic equipment.

From the standpoint of photoroentgenography, it is interesting to observe that the effect of temperature on fluorazure, photoroentgen, and type "B" fluoroscopic screens (Fig. 5) is small. Since the same is also true of radiographic film exposed at high intensity levels there is, therefore, no significant over-all change in the sensitivity of photoroentgenographic and photo-fluorographic materials through a range of temperature extending from -10° C. to 60° C.

ach. They found the technic of the x-ray examination unreliable and were able to demonstrate, by fluoroscopy and films, the actual anatomical appearance of the pyloric stenosis, that is, the narrowed prepyloric canal, which is the first and by far the most important x-ray sign of the disease. It is necessary, according to these writers, to obtain films in the right oblique position, since on an anteroposterior film the pylorus and duodenal cap are often not seen because of their anatomical position posterior to the prepyloric region.



Fig. 1. Normal stomach and pylorus with normal pyloric opening time, seen on right oblique film.

The contention of Meuwissen and Sloof that it is always possible with the correct technic to demonstrate the narrowed prepyloric canal was upheld by many Scandinavian clinicians and roentgenologists (Rinvik, Andresen, Runström, Salmi, Frimann-Dahl). Very little mention is made in American literature of this radiological sign. Some authors believe that x-ray examination is not helpful and not necessary (Knox, Brown, Donovan, Ladd); others attribute some value to it in doubtful cases. The roentgen-anatomical visualization of the narrowed pyloric canal is mentioned by Rigler as being occasionally obtained.

During the last three years many cases of pyloric stenosis have been examined roentgenologically at the Milwaukee Children's Hospital and the Milwaukee Hospital, most of them clinically diagnosed, some of them clinically questionable. Of more than 150 infants examined because of the question of pyloric stenosis, 68 were operated on with the x-ray diagnosis of pyloric stenosis. In all of these the tumor was found and a Ramstedt operation was done. In 3 cases the clinical diagnosis of pyloric stenosis could not be substantiated by radiological examination, and in these no tumor was found at operation. In the other 38 cases where there was a clinical question of a pyloric stenosis, the roentgen examination showed a normal stomach and pylorus, which was proved correct by the later clinical course. Before undertaking this study, 20 normal infants were examined to establish normal findings in infants of between two and four weeks.

One of the most important facts in the correct diagnosis of pyloric stenosis is a knowledge of technical features. Because of the posterior position and angulation of the pylorus and duodenal cap in many infants, often far posterior under the liver, the routine anteroposterior or postero-anterior films of the stomach are, when taken solely, of very limited value or none at all. One may determine the shape and size of the stomach by these views, but they are of relatively no importance. The size of an infant's stomach depends upon its state of filling, be it with food, secretion, or air. The largest stomachs are seen when infants have swallowed a great amount of air. The same stomachs seen on another occasion may be of different size and entirely normal. Nor is the shape of the stomach of any practical importance so far as the x-ray examination is concerned. As many as 12 shapes have been described (Willi), dependent mainly on the food and air content, the filling of the colon with feces and air, and constitutional factors.

Peristaltic waves are normally seen in an infant's stomach, but when the stomach is

overextended by air they may be temporarily absent. Antiperistalsis might be noted before and after vomiting of any etiology.

The pylorus and duodenal cap are, as expected, very small and can be seen only seldom on routine postero-anterior views. It is possible practically always to see them in right oblique and right lateral views (Fig. 1). The best position for their demonstration on films can be determined by fluoroscopy. At times it is necessary to use right oblique films with different rotation of the infant to get the correct visualization. At other times the straight right lateral view will demonstrate the pylorus and duodenal cap when all other views fail.

The pyloric opening time is of considerable importance for x-ray examination. A normal pylorus in an infant will open and discharge barium into the duodenum practically always during feeding. When 2 ounces of a mixture of barium and feeding formula are given, barium is seen to have passed the pylorus in less than five minutes after the feeding is finished. A prerequisite is, of course, an empty stomach, usually obtained by withholding food and water for six hours, rarely by gastric lavage.

If the pyloric opening time is delayed longer than five minutes, the presumptive diagnosis of pyloric stenosis becomes very likely. In most cases of pyloric stenosis the opening time is found to be between fifteen and sixty minutes. In very early cases (4 in this series) it is occasionally normal; in very advanced cases it may be delayed up to three hours, with no barium seen in the duodenum or small intestines at that time (Table I).

TABLE I: PYLORIC OPENING TIME IN PYLORIC STENOSIS, AS CHARTED FROM 68 CASES (Normal pyloric opening time up to five minutes after feeding)

Normal (5 minutes).....	4
Between 5 and 15 minutes.....	20
Between 15 and 60 minutes.....	26
Over 1 hour.....	18
TOTAL.....	68

The emptying time of the stomach in

infants two to four weeks old is normally between two and four hours when 2 ounces of a barium mixture are given. At times a little barium is seen in the stomach after a longer interval. It is of considerably less importance in the diagnosis of pyloric stenosis than it is given credit for in the literature. Of course, when no barium at all has left the stomach in two or three hours, the diagnosis of pyloric stenosis is most likely, that representing a marked delay in the pyloric opening time. In many cases of proved disease with large tumors the



Fig. 2. Postero-anterior film of stomach. Pylorus not visible.

opening time of the pylorus was considerably delayed, up to one hour, and yet the emptying time of the stomach was entirely normal; that is, in three to four hours no barium remained in the stomach. Usually, but not always, the severity and duration of the disease correspond with the delay in the gastric emptying time.

In a few cases it was thought that a thickened gastric wall could be seen on edge when the stomach was filled with enough air to demonstrate it. This sign, however, was of no help.

The sign which is always present and the only entirely reliable roentgen finding is the narrowed prepyloric canal. It is seen as a persistent narrowing of the prepylorus, 1.5 to 2.5 cm. long, corresponding anatomically to the narrowed lumen surrounded by the hypertrophied muscle.



Fig. 3. Right oblique film of stomach with typical prepyloric narrowing and delayed pyloric opening time (30 minutes).

Occasionally one may see it on the postero-anterior film, but in most cases it is hidden by the barium in the more proximal parts of the stomach (Fig. 2). At times it is easily seen fluoroscopically; at other times the fine streak of barium is so narrow that it cannot be made out by the fluoroscopic examination (about 50 per cent of the cases). It is then necessary to determine during fluoroscopy the best position for a film. Not always do the first two or three films show the narrowed canal. At least a minimal amount of barium must have left the stomach for demonstration of the pylorus and duodenal cap. If the pylorus does not open during the time of fluoroscopy and the first set of films, another series of films is taken in thirty minutes and still another one hour afterward (Figs. 3-5). In practically all cases the pylorus and at least part of the duodenal cap can be seen on at least one, usually more than one, film. If there is still a question, a re-examination is done the next day, but this was necessary in only 2 of our 68 cases.

If a normal opening time of the pylorus

and a normal size, length, and width of the pylorus and prepyloric region are demonstrable by fluoroscopy, done 5 minutes after the feeding is finished, and in the first films, no further films are considered necessary, as the emptying time in such cases is of no interest, except for the rare occurrence of duodenal obstruction which may



Fig. 4. Right oblique film of stomach with typical prepyloric narrowing.

be picked out by that time and by clinical impression (the vomitus contains bile in such cases).

Of interest is the observation of the stomach after the Ramstedt operation has been done. Usually the pyloric opening time becomes normal within a short time. The deformity of the pylorus with its narrowing is still demonstrable for a considerable time. According to some Scandinavian authors, narrowing has persisted in some patients up to puberty.

Of importance also is the observation of the esophagus, which, rarely, shows some dilatation and even spasm at the cardiac



Fig. 5. Postero-anterior film showing a typical prepyloric narrowing and a delayed pyloric opening time.

end. In one case an untreatable obstruction developed at the cardia, of immense mucosal folds, leading to a complete obstruction and the death of the infant, after the pyloric stenosis was relieved by surgery.

CONCLUSIONS

(1) Roentgen examination of the stomach in cases of pyloric stenosis allows a correct diagnosis in practically all cases and is often of help to the pediatrician and surgeon.

(2) The pyloric opening time is of much value in diagnosis, while the emptying time of the stomach is of relatively little assistance.

(3) The most important x-ray sign is the actual demonstration of the narrowed prepyloric canal by fluoroscopy and, more important, by films.

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Castration for Advanced Malignant Growth: Short Historical Review with a Case Report¹

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THERE HAS occurred a tremendous resurgence of experimentation to determine the effects of castration on malignant growth, particularly following the publication by Huggins (1) and his associates of their study of orchiectomy in advanced carcinoma of the prostate. This widespread interest is illustrated by the following statement in the Memorial Hospital Triennial Report (2): "The first and most important is the work of Doctor Farrow on the value of orchidectomy in the cases of advanced carcinoma in the male breast," and by numerous publications dealing with orchiectomy for prostatic carcinoma. That such a procedure has not the curative effects hoped for in the first flush of activity is suggested by the recent report of Kretschmer (3).

The first favorable report on the effects of castration in cancer was published over half a century ago (1889) by Schinzinger (4), who described improvement following oophorectomy in mammary carcinoma. This was independently attested to by Beatson (5), who in 1896 described shrinking of the primary breast tumor and its metastases. Dresser (6) more recently reported on improvement in metastases secondary to breast carcinoma following x-ray castration in young women.

It was only logical, then, that experiments be made to determine the value of castration in other neoplastic conditions than those primary in the breast and prostate. Among the studies reported were those of Herbst (7), who obtained temporary improvement in a case of malignant melanoma of the choroid with metastases following orchiectomy.

The following clues have been listed (Howes, 8) which would tend to link melanoma with the sex glands:



Fig. 1. Melanoma arising from conjunctiva of left eye.

"(1) With adolescence there is a localized deposition of pigment in the skin of the genitalia and about the areola of the breasts.

"(2) Pigmented nevi which remain quiescent in infancy and childhood have been known to become activated during adolescence or later in (adult) life. The only reported case of a baby dying of malignant melanoma is that of Parkes Weber (9), who described a case of melanoma transmitted from mother to child *via* the placenta, with death of both."

The following case is presented to illustrate that in our limited experience orchiectomy has had no effect in retarding the growth or diminishing the symptoms of malignant melanoma arising in the conjunctiva.

CASE REPORT

E. W., 47-year-old white male, reported to the Out-Patient Department of the Brooklyn Cancer Institute in January 1942. He had known of the

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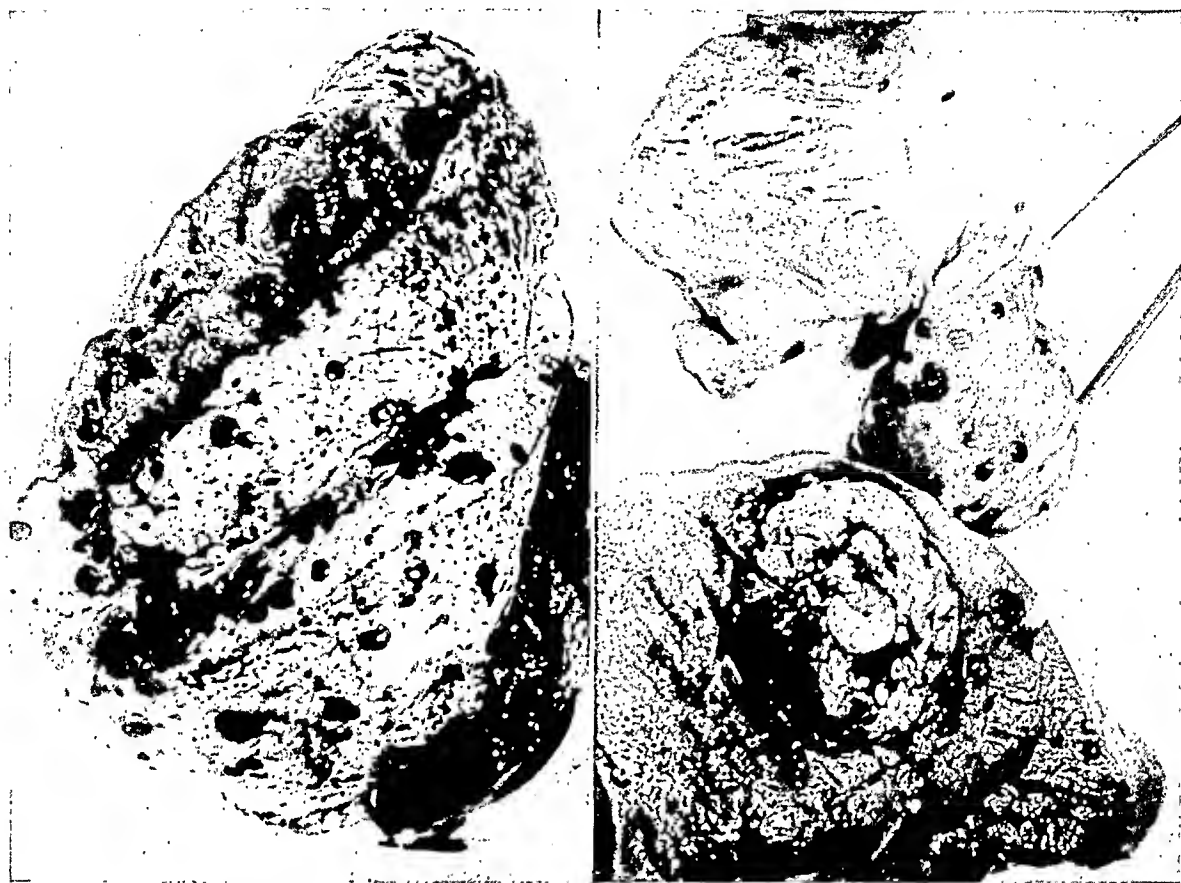


Fig. 2. Metastases in pleura and in myocardium, pericardium, and lung.

presence of a small black spot on the inner surface of his left eye for the past eight years. This had suddenly started growing about one year previously, forming a coal-black fleshy mass filling the inner angle of the eye. There was no pain and no interference with vision. Medical advice was sought merely because the mass was growing and because of its unsightliness.

On examination, a deeply pigmented papilloma measuring $0.25 \times 1.0 \times 1.0$ cm. was seen arising from the conjunctival surface of the left lower lid, with ulceration along the sulcus between the lower eyelid and the orbital conjunctiva. The patient was otherwise healthy, without evidence of metastasis. His liver was not enlarged.

A radical exenteration of the orbit was determined upon as the procedure of choice. This was done in another hospital on Jan. 31, 1942. The pathologist reported the growth as "melanoma of caruncle and conjunctiva, left." Within one month, the skin grafts had taken and the patient was discharged with a favorable prognosis. He remained well, without visible recurrence or metastasis, for about one year.

In February 1943, or approximately one year following the exenteration, a subcutaneous button-like

growth was palpated on the anterior abdominal wall. A biopsy excision proved this to be "melanoma, metastatic." Soon thereafter, bluish-black nodules developed on the roof of the exenterated orbit and innumerable skin metastases appeared, mostly over the trunk. The liver rapidly enlarged, and ascites became evident. About this time the staff of the Brooklyn Cancer Institute determined on an orchiectomy with the hope that the removal of the testicular hormone might impede the growth and spread of these metastatic lesions.

On April 26, orchiectomy was done. There was no operative reaction. The patient, however, continued his downhill course and died on June 24, 1943, without any clinical evidence that the orchiectomy had in any way changed the course of the disease.

Autopsy was done. The following is a summary of the anatomicopathologic diagnosis: Melanoma arising in conjunctiva of left eye (exenteration left orbit); metastasis to the orbital roof; metastasis to skin, both lungs, hilar nodes, pleurae; pleural effusion, right; metastases to pericardium and myocardium; metastases to spleen, liver, kidney, mesentery, peritoneum, omentum; ascites. There was nothing in the gross or microscopic findings



Fig. 3. Metastases in omentum.

to suggest that the orchiectomy had in any way affected the pathological picture.

COMMENT

Caution is suggested before castration is carried out in cases of malignant growth other than those with the primary lesion in the breast or prostate.

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Leukemia in Radiologists¹

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FOR MANY YEARS there has been prevalent an impression of a possible relationship between exposure to radiation and the subsequent development of leukemia. As early as 1911 there appeared the first report on the matter by von Jagic and co-workers (1), in which a brief statement—based in part on hearsay—is made concerning the occurrence of leukemia in four persons who had experienced prolonged exposure to radiation. Of only one of these cases did the authors have any personal knowledge. Since that time there have appeared perhaps a dozen reports on the specific subject of the development of leukemia in persons non-therapeutically exposed to small doses of radiation over prolonged periods. Twenty-three cases have been recorded in the literature, including the four by von Jagic. In a few of the cases details are lacking and the relationship is not well established.

In 1912 Aubertin (2) referred to a case of myeloid leukemia discovered in a French radiologist and followed by Vaquez. In 1924 Carman and Miller (3) reported a case of lymphatic leukemia in an American roentgenologist. The following year Emile-Weil and Lacassagne (4) published a report of myeloid leukemia in a research worker in radioactive bodies and recalled that Bécélère had observed a similar case in a radiologist. In 1927 Davey and Whitby (5) added a case of acute leukemia in a "medical man who had worked with x-rays for many years," and in 1928 Evans and Roberts (6) reported a case of myeloid leukemia occurring in an x-ray worker, at the same time reviewing the ten cases that had been recorded up to that time. They concluded that the case against radiation as a cause of leukemia was not yet proved, since actually only the two cases of Carman and Miller and Emile-Weil and

Lacassagne occurred in persons who were known from definite first-hand information to have experienced prolonged exposures to small amounts of radiation.

Aubertin (7), in 1931, stated that over a period of nineteen years he had the opportunity of seeing five radiologists afflicted with myeloid leukemia, while during the same space of time he had observed only one case in a physician other than a radiologist. Since the radiologists constitute only a small proportion of the medical profession, he concluded, on the basis of his personal experience, that myeloid leukemia is undoubtedly more frequent in radiologists than in other doctors. In the same year Haagensen (8), at the Memorial Hospital, New York, cited a case of leukemia developing in a person exposed to radiation over a prolonged period. The following year a case was added by Nielsen (10) and another by Laubry and Marchal (9). The latter writers quote a case of Znajewska. In 1937 Emile-Weil (11) reported a case of aleukemic lymphatic leukemia in a radiologist and stated: "There have been published more and more cases of leukemia, lymphatic as well as myelogenous, in radiologists, the disorder being an occupational one with them." Weitz (12) in 1938 and Maingot and his co-workers (13) in the same year each added a case. The latter writers quote Lavedan as also having seen a case.

During the year 1943 the writer was impressed by the death of three radiologists from leukemia. It was thought worth while, therefore, to see whether over a period of years there had occurred a higher incidence of the disease among radiologists than among non-radiological physicians. No such statistical study appears ever to have been made; only a vague impression that this greater incidence exists seems to be prevalent as a result of the reports cited

¹ Accepted for publication in June 1944.

above. On the other hand, some persons are not at all convinced that any causal relationship has ever been demonstrated.

The incidence of leukemia in physicians is easily determined through a study of the death notices appearing in the *Journal of the American Medical Association*, since leukemia is a fatal disease. Unfortunately, the cause of death is not given for every physician, but eventually the files of the Association become fairly complete, so that by the time the annual editorial on deaths among the medical profession is written, only 2 or 3 per cent of the deaths recorded remain listed without cause, and this very small proportion is negligible. The total number of deaths listed was therefore used to compute the percentages.

While the present paper was in preparation, there appeared an article by Henshaw and Hawkins (18) in which they reported for a ten-year period an incidence of 0.53 per cent of leukemia among physicians for whom the cause of death was given (26,788). This includes all physicians, radiologists and non-radiologists. The number of cases of leukemia listed by Henshaw and Hawkins is lower than the official figures listed annually by the American Medical Association in its editorial on physicians' deaths. According to the latter, over the fifteen-year period from 1929 to 1943, inclusive, notices of the deaths of 50,342 physicians appeared in the *Journal of the American Medical Association*; 229 deaths were reported as due to leukemia, giving an over-all incidence for physicians of 0.45 per cent.

There is no single agency on file that records deaths of radiologists. For the purposes of this paper, a review was made of all of the death notices that have appeared in *RADIOLOGY* and in the *American Journal of Roentgenology and Radium Therapy* during the fifteen-year period under consideration. Honorary members, foreign members, and laymen whose obituaries were published were omitted from consideration, since they were not pertinent for comparative purposes. Care was exercised to avoid duplication. A complete

list of members of the American Roentgen Ray Society and of the American College of Radiology who had died was obtained, and the deaths not recorded in the above journals were then traced through notices appearing in the *Journal of the American Medical Association*. Lists of deceased members could not be obtained from the other national radiological societies. From the sources stated, however, the writer believes that a representative and nearly complete list of deceased radiologists has been obtained for the latter years of this decade and a half; in the earlier years the total number of radiologists was fewer, and the deaths of only the most distinguished were recorded in the radiological journals. Records of the deaths of a total of 175 radiologists were found during this fifteen-year period. The annual distribution of these deaths is given in Table I.

TABLE I: DEATHS OF RADIOLOGISTS, 1929-1943

1943.....	20	1935.....	8
1942.....	27	1934.....	5
1941.....	17	1933.....	11
1940.....	19	1932.....	7
1939.....	21	1931.....	7
1938.....	8	1930.....	6
1937.....	13	1929.....	1
1936.....	5	Total	175

Of these 175 deaths, the cause is recorded in 173. In spite of the fact that in 2 instances no cause of death is recorded, it does not seem unreasonable to assume that neither was due to leukemia, since a leukemia death would probably have been mentioned because of the possible occupational relationship. At any rate, one is erring only on the side of conservatism in such an assumption. Moreover, the percentage unreported in the radiological group approximates the percentage unreported in the larger group of physicians as a whole. During this period 8 radiologists are known to have died of leukemia, and these 8 cases are listed in Table II. This gives an incidence of all types of leukemia in radiologists of 4.57 per cent, based on deaths during the past fifteen years.

In order properly to evaluate this figure, it would be necessary to compare it with the incidence of leukemia in physicians

TABLE II: DEATHS FROM LEUKEMIA IN RADIOLOGISTS, 1929-1943

Initials	Date of Death	Type of Leukemia Recorded	Age	Location
W. C.	Oct. 17, 1943	Lymphatic	54	Petersburg, Va.
I. G. F.	July 15, 1943	Acute	43	Harlingen, Tex.
C. G. D.	April 23, 1943	Acute myelogenous	42	New York, N. Y.
J. J. L.	Feb. 22, 1942	Acute myelogenous	63	Syracuse, N. Y.
W. W. F.	July 10, 1940	Leukemia	48	Rochester, Minn.
L. J.	Jan. 23, 1939	Chronic lymphatic	65	New York, N. Y.
L. I. L.	June 24, 1938	Leukemia	52	Buffalo, N. Y.
J. F. H.	Feb. 23, 1933	Lymphatic	69	Ottumwa, Iowa

who are not radiologists, for one can assume that the latter group as a whole does not receive any appreciable amount of irradiation, even though a small percentage do use fluoroscopes. There have thus been 50,160 deaths among non-radiological physicians and 221 cases of leukemia, an incidence of 0.44 per cent. The incidence of leukemia in radiologists has thus been more than ten times as great as its incidence in physicians who are not radiologists.

Because of the relatively small size of the group of radiologists, *i.e.*, the sampling, it is necessary to apply some statistical test of significance to the results. There are several avenues of approach. The usual test (15) concerns the use of the probable error of the difference in the two rates of incidence under consideration, employing

the formula $P.E. = \frac{0.67449}{\sqrt{n}} \sqrt{pq}$, where

$P.E.$ is the probable error of the rate of incidence, n the total number of observations, p the proportion of positive cases, and q the proportion of "negative" cases or escapes. Thus, the probable error in the incidence of leukemia in non-radiological physicians is

$$P.E. = \frac{0.67449}{\sqrt{50,160}} \sqrt{0.00441 \times 0.99559} = \pm 0.0002$$

The probable error for the incidence of leukemia in radiologists is

$$P.E. = \frac{0.67449}{\sqrt{175}} \sqrt{0.04571 \times 0.95429} = \pm 0.0106$$

Now, the probable error of a difference between any two independent quantities is equal to the square root of the sums of the squares of their respective probable errors.

Thus

$$P.E._{a-b} = \sqrt{P.E._a^2 + P.E._b^2}$$

where a and b are the independent quantities.

The difference in the matter under consideration is between the percentage incidence of leukemia in radiologists (4.57 per cent) and non-radiologists (0.44 per cent) as given above. Therefore

$$0.04571 (\pm 0.0106) - 0.00441 (\pm 0.0002) = 0.0413 \pm 0.0106$$

since

$$\sqrt{(0.0106)^2 + (0.0002)^2} = 0.0106$$

The difference (0.0413) is 3.9 times as large as its probable error (0.0106), which difference is ordinarily considered as significant.

Because the normal curve is a very poor approximation (17) when the expected number of cases is less than 5 (and in our case it would be 0.8 case at the rate of 0.441 per cent), it is better to determine the probability by the appropriate term in the expansion of the binomial $(p + q)^n$. For the occurrence of 8 cases the appropriate term would be

$$\frac{n(n-1)(n-2)(n-3)(n-4)(n-5)(n-6)(n-7)p^8q^{n-8}}{1.2.3.4.5.6.7.8}$$

This would be equal to 0.0000013, where $n = 175$, $p = 0.0441$, and $q = 0.9559$. This means that there is only one chance in a million of getting 8 cases of a condition by chance alone in a group of 175 where the standard rate of incidence is 0.441 per cent. The observed difference in incidence rate is therefore significant.

DISCUSSION

It is obviously impossible to gauge accurately the amount of protection that

individual radiologists take against direct and scattered radiation, although such an analysis would be desirable from the standpoint of this study. It is a known fact that all of the radiologists here reported as having died of leukemia had been practising radiology for many years. It is outside the scope of this paper to discuss the effects of radiation on the various elements in the blood and blood-forming organs. For this, the reader is referred to an excellent review by Dunlap (16).

If it is assumed that a relationship exists between prolonged exposure to radiation and the development of leukemia, then the fact that a certain percentage of non-radiological physicians are exposed to radiation would tend to increase the validity of the attempted demonstration of such a relationship by the present statistical study, since this factor, if it had any effect at all, would tend to increase the incidence of leukemia in non-radiologists.

Since all radiologists are exposed to a greater or lesser amount of secondary radiation, and occasionally even to primary rays, and since radiation has a biologic effect, it would be desirable to have the causes of death, and perhaps the major illnesses, of all radiologists carefully recorded in some central agency, so that when sufficient data had accumulated, any possible relationship between prolonged exposure to radiation and various disease processes could be studied.

SUMMARY

1. During the past fifteen years 8 radiologists in the United States have been reported as dying of leukemia.

2. These 8 cases are added to the 23 cases of leukemia reported in the world literature as occurring in persons exposed to radiation over a prolonged period, which are briefly reviewed; a few of the latter group are not well substantiated.

3. The incidence of leukemia in radiologists for this fifteen-year period is over ten times as great as the incidence of this condition in non-radiological physicians during the same time.

4. Statistical analysis shows that this finding is significant, *i.e.*, the increased incidence of leukemia in radiologists is far greater than can be accounted for on the basis of chance alone.

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Leukemia in Mice Following Exposure to X-Rays¹

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THE POSSIBLE causal relation between exposure to x-rays and the occurrence of leukemia has been studied in only a few instances. For this report we shall follow the procedure of Richter and MacDowell (1) and use the term leukemia in the broader sense, to cover not only the myeloid, lymphoid, and monocytic forms, but also lymphomatosis, lymphosarcoma, lymphadenosis, and pseudoleukemia.

Krebs, Rask-Nielsen, and Wagner (2) appear to have been the first to carry out investigations on the induction of leukemia by x-rays. With single whole body exposures of 400 r, given to large numbers of mice, the incidence was raised from 0.06 in the controls to 0.35 per cent. Thus, while the actual incidence was still low, the increase amounted to nearly six-fold. Furth (3) gave single whole body treatments of approximately 400 r and found a slight but nevertheless definite increase in leukemia of both myeloid and lymphoid types. Hueper (4), using hard x-rays, gave repeated general body treatments to mice, doses up to 480 r being administered in a six-week interval. He observed an incidence as high as 74 per cent in animals in which, he states, the normal incidence was 19 per cent. Furth and Furth (5) irradiated the whole bodies of mice with single or repeated doses of 200 to 400 r and observed an increase in myelosis as high as eight-fold, and of mediastinal lymphomatosis as high as seven-fold. The actual incidence of lymphomatosis and myelosis, however, did not exceed 13.9 and 7.6 per cent, respectively.

Descriptions have been given and summaries made (6) of the occurrence of leukemia in persons occupationally exposed

to high-energy radiations. Similarities have been pointed out between radiation-induced lesions of the skin and those in hematopoietic organs which later become neoplastic. The plausibility of the idea that radiation may induce leukemia has been openly discussed, but as yet adequate statistical evidence showing a greater occurrence of leukemia among exposed persons is lacking. Henshaw and Hawkins (7) have found the incidence of leukemia in physicians to be approximately 1.7 times greater than in white males of the general population. On the assumption that physicians as a group are more exposed to high-energy radiations than white males of the general population, this observation may be said to be in accord with the findings with experimental animals, but since the higher incidence of leukemia in physicians may be accounted for by other factors, radiation is not fully indicted as the causal agent.

In the studies with animals previously reported, doses of 200 to 400 r were used, and not much attention was given to the number or frequency of treatments. Hence, while some positive evidence was obtained indicating that radiation may induce leukemia, the actual incidence was never high (except in Hueper's experiments, in which the strain used had a high spontaneous incidence), and it would appear that the optimum conditions for induction had not been found. In our experience with different strains of mice (8), doses of 200 to 400 r applied acutely to the whole body were sufficient to produce a modification of the peripheral blood picture and marked destruction of hematopoietic tissues. It seemed plausible, then, that the increased incidence of leukemia might be related to the destruction of hematopoietic tissues and that a greater increase might be obtained by increasing the

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

TABLE I: NUMBERS OF DEATHS AT DIFFERENT TIMES AFTER TREATMENT WAS BEGUN

Type of Disease	Months After Treatment						Total Number of Deaths	Per Cent Leukemia
	1-3	4-6	7-9	10-12	13-15	16-18		
Males (28)								
Leukemia	0	0	1	5	1	0	7	25.0
Other causes	1	0	4	3	5	8	21	
Females (29)								
Leukemia	0	0	7	2	1	0	10	34.5
Other causes	1	0	5	7	5	1	19	
TOTAL							57	29.8

amount of destruction. With this in mind, experiments were planned whereby considerable damage could be produced in blood-forming organs during an appreciable interval of time.

METHODS AND MATERIAL

Since single doses of 400 r are lethal to some animals, and inasmuch as return to a normal blood picture after such exposures requires three to four weeks or more, it was decided to use doses of 200 r repeated at four-week intervals as long as this could be done without too severe an effect on the health of the animals. Arrangements were also made to obtain continuous leukocyte records on some of the animals.

C57 Black mice obtained from the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, were used exclusively for the experiment. This strain of mice was used, since it was known to have a spontaneous incidence of leukemia not greater than 10 per cent (9). Fifty-seven animals (28 males and 29 females) were exposed to radiation. Treatment was begun when the animals were three to four months old. A similar group of 60 animals was maintained under the same conditions (except for treatment) as controls. Total and differential leukocyte counts were made on 10 animals of the experimental and control groups at fortnightly intervals.

The x-ray equipment used consisted of the dual-tube simultaneous cross-firing apparatus available at the National Cancer Institute. The conditions used were: 200 kv., 20 ma. 0.5 mm. copper and 1.06 mm. aluminum filter and a distance of 38 cm. from each target. The intensity at the

level of the mice was 121 r per minute as measured in air with a Victoreen ionization chamber. Hence, the exposure time for delivering a dose of 200 r was 1.65 minutes. During treatment the mice were held in a shallow, light-weight celluloid tray. Following treatment they were kept under constant observation until death, at which time they were examined grossly and histologically for leukemia. The data to be given are derived exclusively from the present experiment. Some of the details concerning the gross and histologic changes, however, are drawn in part from other more extensive experiments now in progress.

RESULTS

Table I shows the number of animals dying with leukemia at different times after treatment, the data for males and females being shown separately. Deaths from leukemia occurred during the interval of seven to fifteen months after irradiation, for the most part between the seventh and twelfth months. As shown in the last columns, 7 of 28 males, or 25.0 per cent, died with leukemia and 10 of 29 females, or 34.5 per cent. While these figures indicate a greater frequency in females, the difference for these limited data is not regarded as significant. By averaging the values for males and females, a figure of 29.8 per cent is obtained. In a similar group of 60 control animals maintained under similar conditions, only 4, or less than 7 per cent, died with leukemia during a corresponding period.

The gross and histologic picture as seen at death showed differences as well as simi-

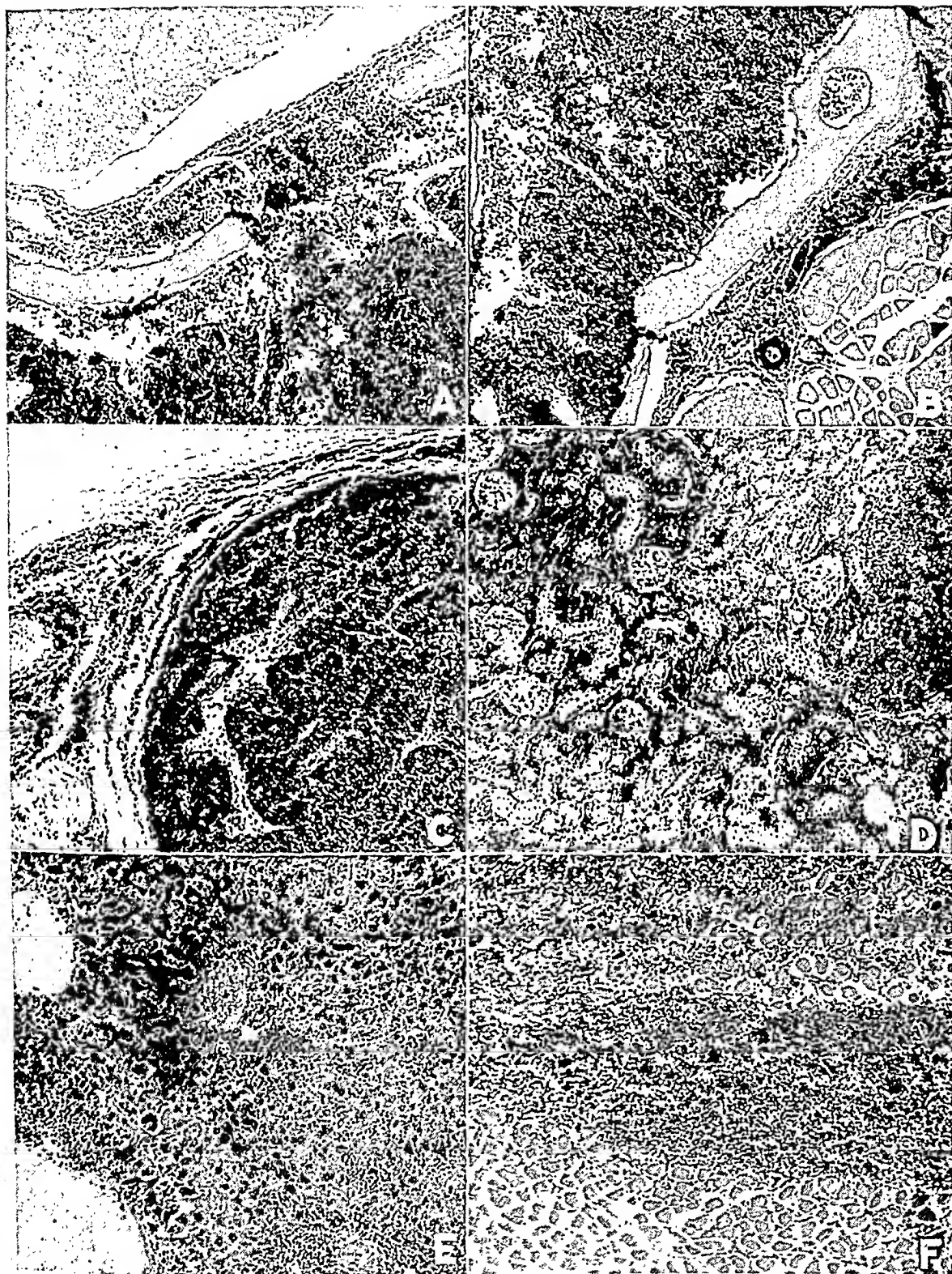


Fig. 1. Leukemic invasiveness in different organs. *A.* Meninges. *B.* Paravertebral connective tissue. *C.* Lymph node capsule and connective tissue. *D.* Kidney. *E.* Liver. *F.* Skeletal muscle (near sternum). Hematoxylin and eosin. $\times 100$.

larities in the various animals. Mediastinal masses in the region of the thymus were most frequently seen. These sometimes measured 8 to 12 mm. in diameter and often formed apron-like extensions which surrounded and became attached to the heart and lungs. In some instances the masses were attached to and infiltrated the chest wall. This thymic enlargement was in some cases accompanied by general enlargement of lymph nodes and spleen and an increase in young leukocytes in the circulating blood, but more often only thymic enlargement and slight general lymph node enlargement were observed. In occasional animals the thymic enlargement was absent while lymph node or splenic hypertrophy indicated the leukemic state. As will be shown below, a modified blood picture sometimes accompanied the disease, but more often it did not.

The only unvarying characteristic which was depended upon fully for diagnosis was invasiveness of leukocytes from normal sites into adjacent tissues. Figure 1 shows typical examples. *A* and *B*, respectively, show invasion of the meninges and of the paravertebral connective tissue from vertebral bone marrow. *C* shows invasion of the capsule and connective tissue surrounding an axillary lymph node. *D*, *E*, and *F*, respectively, show leukemic infiltration of kidney, liver, and skeletal muscle (near sternum). The degree of invasiveness varied from animal to animal, some showing only traces. The line of separation between the normal and diseased tissue was, in fact, not sharply defined, making diagnosis difficult. For the table above, all cases listed as positive showed extensive invasiveness and all questionable or borderline cases are listed as negative.

In order to illustrate further the necessity of depending upon invasiveness for diagnosis, one case in particular will be described. Shortly before death in the eighth month after treatment, this animal exhibited paralysis of the hind legs, the only case of this kind seen. The peripheral blood picture was negative at autopsy, and all organs displayed a normal appearance

with the possible exception of the mesenteric lymph node and the thymus, which were slightly enlarged. The gross picture, therefore, gave no explanation of the paralysis nor any clue as to the cause of death. Histologic sections of the spine, however, revealed a hyperplastic vertebral marrow, a packing of the meningeal spaces with leukocytes, and invasion of the paravertebral musculature. The paralysis was thus readily accounted for, and the animal was classed as a positive leukemia case.

Figure 2 shows continuous blood records on 3 representative animals. *A* is for a non-irradiated control animal and *B* and *C* are for animals that received doses of 200 r at intervals of four weeks, as indicated by the arrows. Continuous blood count records were made on 5 females and 5 males from each group, and attempts were made to obtain counts for at least a short period on most of the animals shortly before death. The graphs in Figure 2 were selected for presentation because they are typical of the blood records obtained.

In graph *A*, the leukocyte level ranges generally between 8,000 and 13,000 cells per cubic millimeter of whole blood. Only once was this animal found to have a count significantly higher than 15,000. In our experience generally, leukocyte counts in the range of 20,000 to 30,000 have been found occasionally in animals which were presumably normal, but such levels were never sustained for periods of several days or weeks. In C57 Black mice the lymphocyte level runs higher than that of the neutrophil, as a rule. A few (5-10 per cent) younger forms were present normally, but only rarely were blast forms seen.

With reference to the treated animals, *B* and *C* differ from each other and also from the controls. During treatment the changes were generally the same for both *B* and *C*, consisting of a gradual development of leukopenia. When five or six treatments had been completed, the leukocyte level was in the range of 1,000 or below, both lymphocyte and neutrophil levels being markedly affected. Beginning soon after the last treatment, or perhaps shortly

before (*B*), some evidence of recovery developed. In the case of *B*, recovery never went beyond the normal level and the lymphocyte and neutrophil counts continued to be generally characteristic of normal animals. *C*, on the other hand,

disease in this case was considered to be typical leukemia with involvement of the peripheral blood. Animal *B* at autopsy was also found to have a primitive type cell invading many tissues. The photomicrographs shown in Figure 1 were ob-

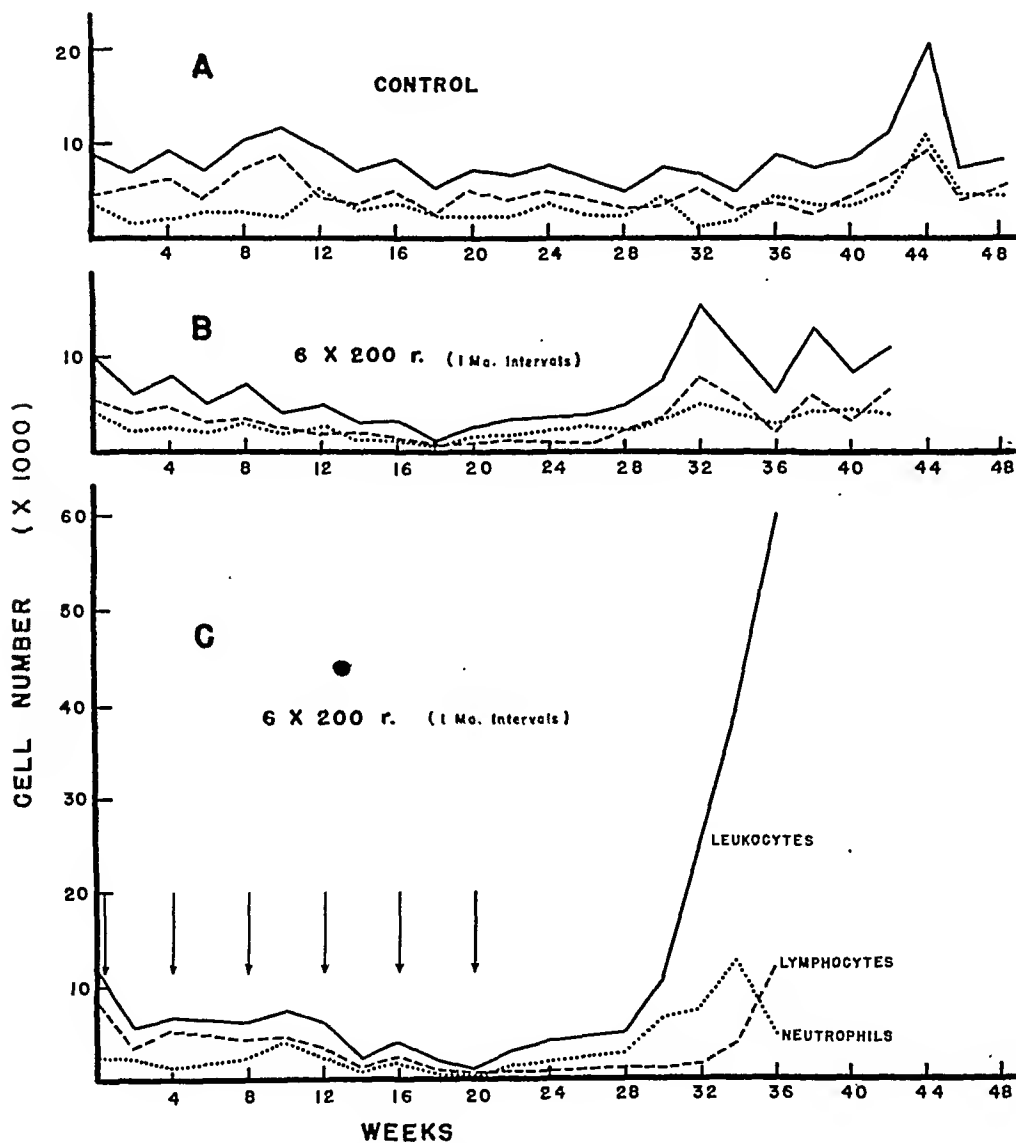


Fig. 2. Continuous blood records on individual mice. *A*. Control. *B* and *C*. Experimental animals receiving 200 r exposures at intervals indicated by arrows. The solid, dash, and dotted lines represent absolute numbers of leukocytes, lymphocytes, and neutrophils, respectively.

after having a fairly normal recovery, suddenly showed an extensive rise in leukocyte level, the predominant cell type being primitive in character. Histologic sections taken at autopsy showed this cell form to be invading the tissues of many organs. The

tained from this animal. In this case, the disease was also considered to be leukemia but not involving the peripheral blood. Protocols from the present experiment and others now in progress contain several records like *C* and several like *B*. Actually

the *B* type has been seen more often than *C*, and some of these show even less fluctuation near the end than indicated in *B*.

DISCUSSION

The work described here gives further evidence that the incidence of leukemia can be increased in laboratory animals by exposure to ionizing radiations. The incidence obtained with the methods used was very nearly 30 per cent. With the exception of Hueper's figure (based on animals with a high spontaneous incidence) this value is the highest yet obtained. Since the normal incidence of leukemia in the strain of mice used, however, was 7 per cent, it is obvious that the increase amounted to approximately four-fold. In this respect our findings lie intermediate among those of the previous workers.

In the present experiment, it was our aim to employ doses definitely injurious to the hematopoietic organs and tissues and to carry the damage as far as the vitality of the animals would permit. As made evident by the curves (Fig. 2), doses of 200 r produced depressing effects on the leukocyte level and the effects were to some extent additive when treatments were given at intervals of four weeks. From previous experience (8) it was known that doses of 200 r induce extensive damage and destruction in hematopoietic organs, particularly to free lymphocytes, and that periods of three to six weeks or more are required for return to normal. After four to six 200 r treatments had been given in the present experiment, the leukocyte numbers were reduced to dangerous levels (1,000 per cubic millimeter or less), and the animals were uniformly in a cachectic state. For these reasons the treatments were discontinued when six had been given.

The figures given indicating the incidence of leukemia are conservative. Only unquestionable cases were classed as positive, all others being considered as negative. A few animals died early of intercurrent disease and some were cannibalized to the point that satisfactory examinations could not be made. It may be presumed that in

some of these leukemia would have developed if they had lived long enough, but this group together with the borderline cases accounted for less than 20 per cent of the animals. At least half of the animals showed no evidence of the disease, thus making it plain that a still greater incidence might be obtained with more carefully planned treatments. Other experiments are in progress testing other treatment procedures.

The over-all picture thus far obtained is as follows: The radiation produces destructive effects in the blood-forming tissues, changes which become reflected in the peripheral blood as leukopenia. If the damage is not too severe, recovery takes place over a period of weeks or months. Either associated with or following the regenerative process, hyperplasia and neoplasia of hematopoietic tissues develop, which may or may not have manifestations in the peripheral blood. When true leukemia does occur, the onset is sudden and the rise in leukocyte level is rapid (Fig. 2, *C*). A number of continuous blood records have been kept for treated animals that developed true leukemia, and this picture was invariably obtained. Since the animal *B* (Fig. 2) showed leukemic infiltrations, it might be argued that the oscillations in leukocyte level between thirty and forty weeks constituted evidence of leukemic manifestations in the peripheral blood. This might indeed be the case but, since the differential picture was little if any altered and since the leukocytosis did not exceed limits often seen in untreated animals, this possibility is regarded as unlikely. Other records have, in fact, been obtained for leukemic animals which showed no such oscillations. It seems proper, therefore, to regard manifestations in the peripheral blood as secondary effects. Hyperplasia and invasiveness were seen without increased leukocytosis in the peripheral blood, but extensive leukocytosis was never observed without hyperplasia and invasiveness. The site of the disease has appeared problematic, with a slight predilection for the thymus. Hyper-

trophy occurred in one group of hematopoietic organs in one animal and in another group in a different animal, suggesting that the various blood-forming organs have about the same susceptibility irrespective of location.

Little has been said thus far regarding cell types. In general, the forms were undifferentiated and indeterminate. For the most part, they were uniformly similar in any given animal. Perhaps the most significant observation was that the cell type was not the same for all animals, although the same treatments had been received under the same conditions in all cases.

SUMMARY

1. X-rays in doses of 200 r were applied acutely to the whole bodies of C57 Black mice at intervals of four weeks for twenty weeks, and the animals were watched for the occurrence of leukemia.

2. Leukemic disease was found in approximately 30 per cent of the treated animals, but in only 7 per cent of non-irradiated controls.

3. Continuous blood records showed a general depression of leukocyte level during treatment, followed by a slow return to normal after treatments were discontinued. In some animals, the recovery extended into a marked leukocytosis, and these animals at death were invariably found to have leukemic infiltrations.

4. Hyperplasia of hematopoietic organs and invasiveness were seen in all animals recorded as positive, but the distribution of such conditions varied from animal to animal.

5. Primitive cells were seen as the predominant type in all cases. For the most part, the type was uniform in any one animal but varied from one animal to another.

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Industrial Radiation Hazards¹

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THE PRESENT industrial expansion has resulted in vastly increased use of x-rays and radium in the examination of materials and manufactured products. Today these applications of roentgen and gamma rays have reached a volume exceeding that of medical radiology and the exposure of a thousand films a day is not unusual for an industrial equipment.

In order to avoid a repetition of the injuries suffered by the pioneers of medical radiology, it is essential that the industrial users be thoroughly acquainted with the detrimental effects of radiation. At the same time they should have sufficient understanding of the protection problem to realize that with proper safeguards their work does not entail greater hazards than occur in other fields. These safeguards consist essentially in reducing the unwanted, or stray, radiation to a negligible amount, thereby preventing superficial injuries to the skin and hair as well as harmful systemic changes, particularly in the blood and genetic cells.

On the basis of experiences gained over a period of years in medical radiology, it was estimated that a person may be exposed without danger to 0.2 r per day (or 10^{-5} r per second). This amount, the *daily tolerance dose*, does not, however, allow for the special conditions of industrial radiology or for possible genetic effects necessitating a greater margin of safety. The value of 10^{-5} r per second is based on a thirty-five-hour week, while today many industrial employees work fifty hours or more. Furthermore, the wider beams of radiation and higher voltages frequently used industrially increase the volume dose, that is, the total amount of radiant energy absorbed by the body.

Geneticists (5) have advocated that the tolerance dose be reduced to 0.02 r per day, or less, to avoid possible damage to future generations due to the cumulative effects of radiation on the gonads. Yet that point of view is not supported by the fact that the human race has been exposed for ages to cosmic radiation, at the rate of about 0.03 r per year. This question, therefore, is by no means settled and, until more experimental and clinical evidence is available both on the genetic and the volume dose effects, it may be well to apply a factor of safety according to the voltage used, the size of field, and the type of person to be protected. Obviously, better shielding should be provided for x-ray and radium workers than for persons only infrequently exposed to radiation.

This report is a summary of the writer's experiences gained from stray radiation surveys of about fifty industrial installations using voltages from 30 up to 1,000 kv. and gamma rays. The instruments used in these measurements were similar to those previously described (3, 4) and included ionization chambers with air volumes of 435 c.c. and 6,000 c.c. as well as Geiger-Müller counters.

PROTECTION AGAINST DIRECT RADIATION

Stray radiation may be reduced materially by enclosing the x-ray tube in a so-called rayproof housing provided with a small aperture practically limiting the primary rays to the useful beam. The protective qualities of such enclosures have been discussed in our earlier papers (3, 4). It was found that the stray radiation from "rayproof" tube holders generally is less than 1.0 r per hour at a target distance of 1 meter and with the x-ray tube operating at its maximum continuous rating. This is ample protection where

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additional shielding is provided in the walls of the x-ray room but still insufficient to permit manipulation of the tube enclosure while the tube is energized even if the aperture is closed by means of a shutter.

Further protection must be provided against that part of the useful beam not absorbed by the object and against the secondary rays emitted by any material exposed to radiation. The amount of protection needed will depend mainly upon the tube voltage used, the milliamperes-minutes of exposure, and the distance to the x-ray tube target. As the dose varies inversely as the square of the distance, this last factor has a far greater significance than is generally realized. Of the various materials suitable as barriers to the rays, lead is generally the most economical, although concrete may be used to advantage for higher voltages or where it already is part of the building construction, as in floors and ceilings. The International Commission on X-Ray and Radium Protection has formulated certain minimum protection requirements (6), based primarily on medical applications without consideration of the special conditions of industrial radiology. The recommended lead protective values are given for different x-ray tube voltages, without taking into account the milliamperage, target distance, and exposure time. As was demonstrated previously (3, 4), compliance with these rules has given a high factor of safety for medical applications. Better protection, however, and greater economy, may be attained for industrial installations by considering all the factors affecting the thickness of lead required.

In Figure 1 is shown the relationship between the required lead thickness and target distance for various voltages, assuming the x-ray tube is operating at 10 ma. for fifty hours a week and the daily tolerance dose is 0.1 r as recommended by the National Bureau of Standards (9). This chart indicates graphically the results of our absorption measurements made on equipment commonly used industrially.

The values for 125 kv. and less were obtained with x-ray tubes having an inherent filtration equivalent to 0.5 mm. Al and energized by half-wave two-valve generators. The self-contained half-wave type of equipment with an inherent filtration of about 3 mm. Al was used at the higher voltages. The dosage rates of different installations checked within 10 per cent and are generally somewhat lower than those obtained by Binks (1). This might be expected, as his values are for constant potential, while ours are for pulsating potential, which is the voltage wave-form of most industrial x-ray units used in this country.² It is interesting to note that we both obtain a relatively higher lead thickness for 100 kv. than indicated in the International Recommendations. This chart assumes an average exposure of 5,000 milliamperes-minutes a day, which is generally the maximum with present x-ray tubes for one shift, and considerably above that used with any of those examined.

It should be noted that even a marked change in the milliamperes-minutes does not alter materially the lead protection required. For instance, doubling the exposure at 100 kv. increases the lead thickness only 0.2 mm. and at 200 kv. only 0.4 mm. This is illustrated in Figure 2, where the data are given for different daily exposures expressed in milliamperes-minutes or milliamperes for continuous operation. This chart, too, is based on a daily tolerance dose of 0.1 r but may be used for any other value merely by multiplying the milliamperes-minutes used by the desired factor of safety. The required lead thickness is obtained by drawing a horizontal line through the intersection of the two diagonal lines representing the target distance and the daily exposure used. The vertical projection of the intersection of this horizontal line with the curve for the applied voltages will then indicate the required lead thickness.

² Comparative measurements at 200 kv. constant potential checked closely with Binks' data and showed an increase of only 5 to 10 per cent in lead thickness over pulsating potential.

Example: An x-ray tube is operating 8.3 hours a day at 200 kv. and 5 ma. What lead thickness is required at a target distance of 5 meters? *Answer:* Since $8.3 \times 60 \times 5 = 2,500$ milliamperere-minutes, follow the horizontal line from the intersection of the 5-meter and the 2,500-milliamperere-minute lines till it crosses the 200-kv. curve; then follow the vertical line to 3.0 mm. lead, which is the thickness required.

ing simultaneously, the lead shielding must be increased accordingly.³ If the tubes operate at the same voltage, the shielding for *each* must be calculated for the total exposure of *all* the tubes.

Most of the reported industrial radiation injuries have been caused by ignorance or neglect rather than insufficient thickness

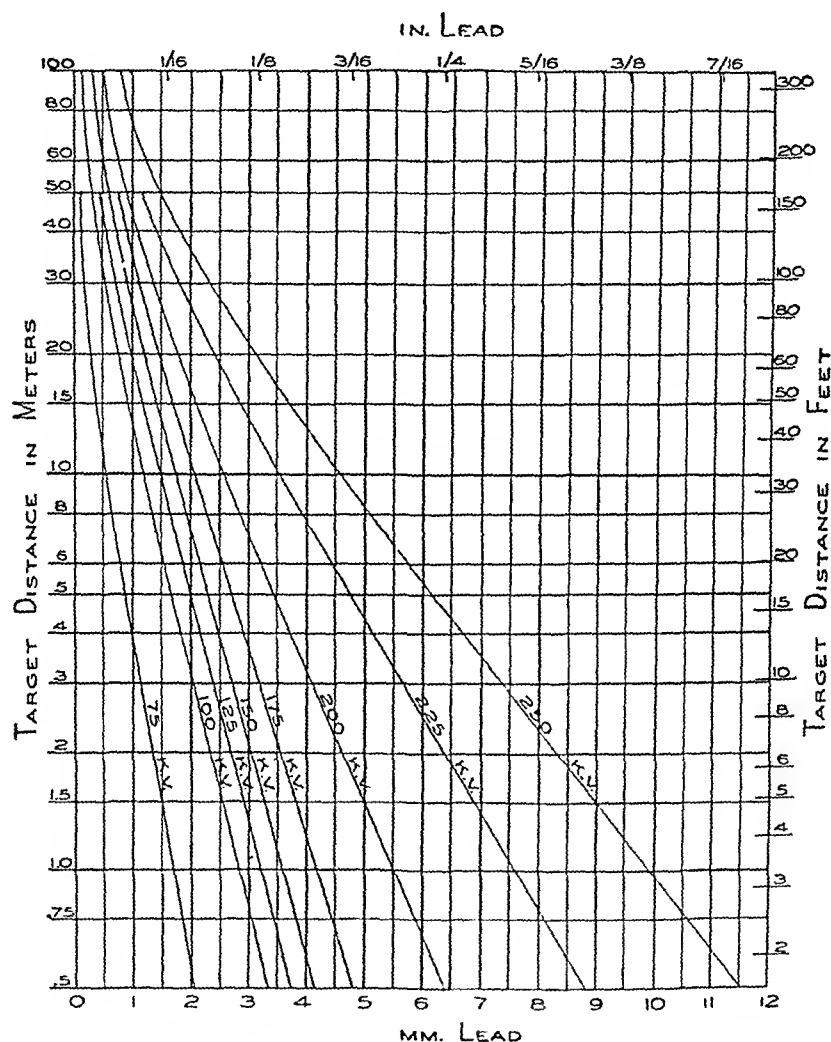


Fig. 1. Lead thicknesses required for different voltages to reduce the daily dose to 0.1 r for 10 milliamperes continuous operation.

In planning industrial protection it is advisable to assume that the x-ray tube is operating at its maximum continuous rating. Experience has shown that most installations eventually operate at much higher outputs than originally planned. Where the personnel are exposed to stray radiation from several x-ray tubes operat-

ing simultaneously, the lead shielding must be increased accordingly.³ Many of the routine x-ray examinations are carried out by non-

³ This is of particular importance in plants manufacturing x-ray tubes, or other electronic tubes emitting x-rays, where large groups of these are being operated for pumping or test.

⁴ The effects of systemic injuries caused by prolonged exposure to weak radiation may not show up for years. The fact that nothing has happened is not proof that the installation is safe.

technical workers, and the possibility of accidents is great unless the equipment is made foolproof with automatic means of preventing exposure to direct radiation; this is especially true of x-ray diffraction units, which are now used in large number for orientation of crystals. Of the four types of units examined, only two pro-

Routine fluoroscopic inspections are usually carried out with apparatus designed for the particular type of object to be examined. To obtain maximum protection, both the x-ray tube and object should be located in a shielded enclosure with a lead-glass window⁵ for observation of the fluoroscopic screen. Where the

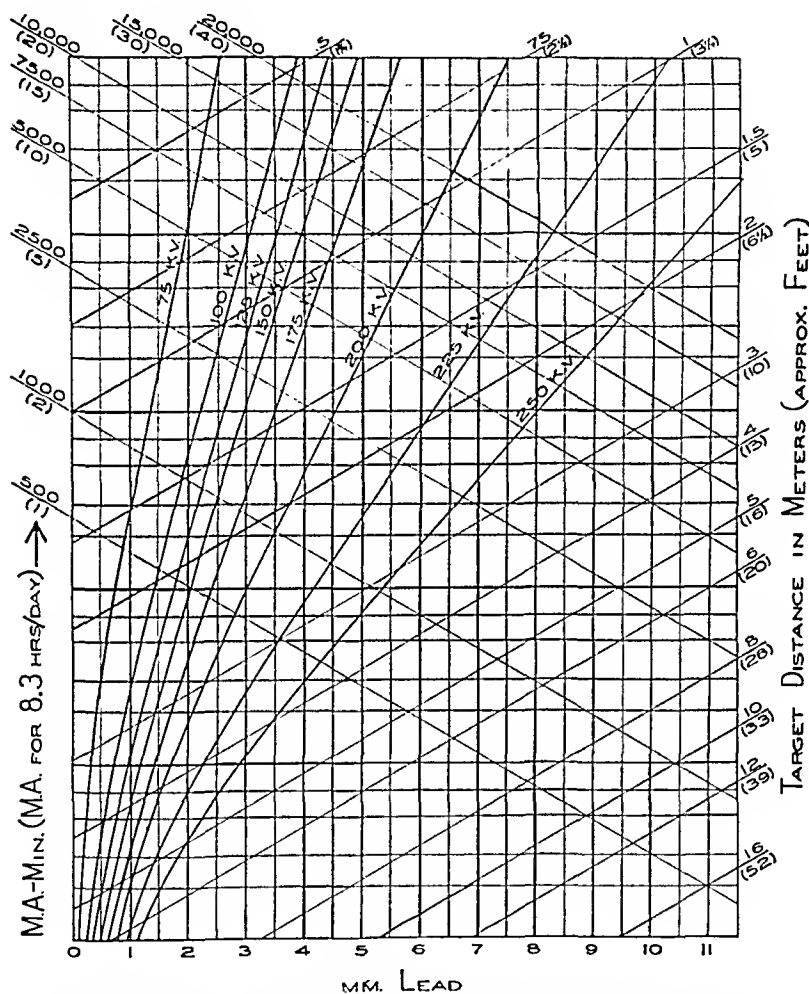


Fig. 2. X-ray protection chart for different voltages, milliamperes and distances. The daily tolerance dose is assumed to be 0.1 r.

vide *automatic* shielding to prevent exposure to the hands of the operator while placing or removing the crystal. With the other two types, a careless worker might readily have her fingers exposed to the intense direct beam of unfiltered radiation, usually 30 kv. and 20 ma. with a target distance of only 10 cm. There are already several reports of skin ulcers caused by such conditions.

target screen distance is short, it may be necessary to use a greater thickness of lead shielding than indicated in the International Recommendations. The values may be determined from the graph of Figure 2. Door switches should be provided to break

⁵ The lead glass should have the same "lead equivalent" as the wall in which it is mounted. By its lead equivalent is understood the thickness of lead which has the same absorption for a particular radiation as the lead glass.

the high-tension circuit and thereby prevent exposure to the direct beam while the enclosure is open.

Unfortunately, occasional fluoroscopy is often carried out with discarded medical equipment, with protection far from adequate for industrial purposes. Many of the superficial radiation injuries have taken place with apparatus of the make-shift type, often because the operator has moved the object with his unprotected hand in the direct beam. Even with standard lead rubber gloves (lead equivalent 0.5 mm.) this is a dangerous procedure for voltages above 75 kv. and is not advisable at any voltage.

Over-exposure to direct radiation is unlikely with radiographic installations where both the x-ray tube and the object are completely enclosed in shielded rooms or booths. Of installations of this type which were examined, only two had inadequate protection against the direct beam. Some had excessive rayproofing, such as lead lining of outside walls, although they were far removed from other buildings.⁶

The use of separate shielded enclosures for radiographic study of large objects is not always practical, as it would require enormous rayproofed rooms and would necessitate additional handling of the material. Instead, a completely lead-lined control booth provides protection to the operator, with the beam directed in such a way that the exposure to other workers is well below the tolerance dose. In some plants, adequate protection has been obtained by using the object as the only barrier to the direct beam. This is possible if the film is placed inside the object, as is the case in radiographing welds of high-pressure vessels or pipes; otherwise, the amount of radiation required to expose the films would cause excessive stray radiation. It is obvious that with this arrangement a large group of workers

might readily receive radiation injuries unless the x-ray tube were energized only when the object covered the whole aperture. Measurements at such installations indicate that with 400 kv. and 5 ma. the daily dose for eight hours' operation, without any object in place, is almost 200 r at a target distance of 10 feet, and 0.1 r at a distance of 450 feet. With the usual type of object in place, the daily dose was only 0.2 r at 10 feet. Actually the stray radiation was considerably less, as the average cumulative exposure time was only a few hours a day.

PROTECTION AGAINST SCATTERED RADIATION

Most of the cases of inadequate protection investigated were due to insufficient shielding against the scattered rays emitted by any material exposed to radiation, such as the object being radiographed or the floor, walls, and ceiling of the x-ray room. While scattered radiation is only a small fraction of the incident radiation, less than 1.0 per cent, it may readily cause excessive stray radiation unless proper shielding is provided. The thickness of lead needed may be estimated from the chart in Figure 2 by dividing the actual milliamperem-minute exposure by 100 and then using the chart in the same way as for direct radiation. The value thus obtained will be on the safe side where "rayproof" tube enclosures are used. Greater accuracy may be secured by considering all the conditions of each case and the lower penetrability of the scattered rays. Taylor (12) and Binks (1) have discussed this subject in detail and reference should be made to their papers. At one installation where the x-ray tube was mounted in an open lead-glass bowl, the stray radiation was about 0.5 r per hour at the operator's position. This was caused by scattering from the ceiling, as the lead protection of the wooden partition extended up only about six feet. The source of stray radiation was located by means of a Geiger-Müller counter constructed to give directional effect.

⁶ It may sometimes be necessary to rayproof outside windows and walls to protect occupants of neighboring buildings. Such protection eliminates, also, "back-scatter" from nearby walls, which may cause excessive exposure to people in adjoining rooms.

As scattered radiation is approximately proportional to the area irradiated, it is important to limit the cross section of the direct beam to that actually required. This is often neglected, although in some instances it has been possible to cut the stray radiation in half merely by adding a lead diaphragm to the aperture of the tube. Another advantage of reducing the scatter is the resultant improvement in the quality of the radiograph.

get and with maximum field size.⁷ The ratio of the stray to the direct axial radiation, both measured through 18 inches of concrete, is about 5 per cent for the same target distance. The stray radiation was determined perpendicularly to the central beam at the level of the target and included primary radiation not absorbed by the tube housing as well as the scatter from the floor. Further tests showed that the stray radiation was due almost entirely to

TABLE I: X-RAY PROTECTION REQUIRED TO REDUCE THE DIRECT RADIATION TO 0.1 R PER DAY

(The protection is given for different exposures per day indicated in milliamperes-minutes and corresponding milliamperages for continuous operation)

Distance		400 kv.								1,000 kv.							
Meters	Feet (Approx.)	1,500 ma.-min. (3 ma.)				2,500 ma.-min. (5 ma.)				500 ma.-min. (1 ma.)				1,500 ma.-min. (3 ma.)			
		Lead		Concrete		Lead		Concrete		Lead		Concrete		Lead		Concrete	
		mm.	in.	cm.	in.	mm.	in.	cm.	in.	mm.	in.	cm.	in.	mm.	in.	cm.	in.
1	3	17.5	11/16	30	11 3/4	18.5	3/4	31	12 1/4	...	...	...	...	...	...	...	...
2	7	14.9	5/8	26	10 1/4	15.8	5/8	27	10 3/4	...	...	88	35	...	...	105	41
3	10	13.4	9/16	24	9 1/2	14.3	9/16	25	9 3/4	...	...	77	30	...	...	93	37
4	13	12.2	1/2	22	8 1/2	13.2	1/2	23	9 1/4	...	...	68	27	...	...	84	33
5	16	11.3	7/16	21	8	12.4	1/2	22	8 3/4	...	...	63	25	...	...	78	31
6	20	10.7	7/16	20	7 3/4	11.7	1/2	21	8 1/4	73	2 7/8	58	23	...	...	73	29
8	26	9.6	3/8	18	7	10.5	7/16	19	7 1/2	67	2 5/8	52	21	...	...	65	26
10	33	8.7	3/8	17	6 1/2	9.7	3/8	18	7 1/4	63	2 1/2	46	18	73	2 7/8	58	23
20	66	6.1	1/4	13	5 1/4	7.1	1/4	15	5 3/4	49	2	...	...	60	2 3/8	43	17
30	98	4.6	3/16	11	4 1/4	5.5	1/4	12	4 3/4	41	1 5/8	...	...	52	2	...	...
40	131	3.5	1/8	9	3 1/2	4.4	3/16	10	4	35	1 3/8	...	...	46	1 7/8	...	...
50	164	2.7	1/8	7	2 3/4	3.6	1/8	9	3 1/2	30	1 1/4	...	...	41	1 5/8	...	...

A large volume of radiography is done by means of turntables, sliding trays, and other automatic arrangements to bring the film and objects into position. Such devices require expert construction to avoid scattered radiation and should be provided with interlocking switches.

400-KV. AND 1,000-KV. INSTALLATIONS

Much more attention has been given to the protection problem for higher voltages, and as a result the factor of safety is generally high. In Table I are presented the results of our measurements at 400 and 1,000 kv. The concrete thicknesses for 400 kv. have been calculated from our lead values, with the conversion factors of Singer, Taylor, and Charlton (11). The measurements at 1,000 kv. were made with the transmission-type tar-

direct rays from the tube and generator housing, rather than from the floor.

RADIUM PROTECTION

The safe use of gamma rays for industrial radiography requires precautions similar to those used in radium therapy. These are given in detail in the recommendations of the National Bureau of Standards (8) and recently have been summarized by Quimby and Pool (10). There are, therefore, only a few points which need be stressed here. Structural shielding is rarely of value in the industrial applications of gamma rays. Even a 1-inch lead barrier will transmit about 25 per cent of the incident radiation, and the same reduction may be obtained by merely doubling

⁷ The protection requirements will be less for smaller fields and where the tube is operated only with the object in place.

the radium distance, as the dosage rate of gamma radiation also varies inversely as the square of the distance. Shielding, therefore, is used mainly while the radium is not in use and can be stored in lead containers. The amount of lead required will depend on the amount of radium, the distance, and the cumulative time of exposure. The thickness may be obtained directly from the Failla protection chart (8) or estimated from certain simple factors. The dose of 1 gm. of radium, filtered through 0.1 cm. lead, is about 6.7 r for eight hours at a distance of 1 meter. Each half an inch of lead cuts the radiation approximately in half. To reduce the daily dose to 0.1 r, the tolerance dose, would therefore require about 3 inches of lead under the above conditions.⁸ Without shielding, the distance would have to be increased to about 8 meters to obtain the same reduction in dose. The area within that radius is considered the danger zone and should be so marked.

DISCUSSION

The results of this study indicate clearly that a higher factor of safety and greater economy may be obtained in planning industrial x-ray protection on the basis of all the factors involved instead of simply the tube voltage, as has been the general practice in the past. Such determinations have been simplified by charts provided for the usual range of voltage, milliamperes-minutes, and distance. The obtained lead thicknesses are based on the average dosage rates of industrial equipment, as the small variation between different generators has no significant bearing on the lead required.

Industrial radiation injuries are not necessarily eliminated by adequate structural shielding and safe equipment. Of equal importance are the training and practice of the technicians in safe operating procedures and their understanding of the fundamental technical and clinical aspects

of protection, which not only reduces radiation hazards but also eliminates unfounded worries, so frequently caused by misinformation.

In order to maintain a high degree of protection, it is necessary to check periodically the stray radiation received by industrial x-ray and radium workers. This may be done most readily by means of dental films carried on different parts of the body for a period of one month. The dose received may be estimated by comparing the density of the test films with control films exposed to known fractions of a roentgen, using radiation of similar quality. Pocket ionization chambers should be used in place of the films where greater accuracy is indicated. Either method of stray radiation control serves also as an incentive to the personnel to avoid unnecessary exposure and at the same time gives them a sense of security when the stray radiation is proved to be negligible.

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⁸ Where greater accuracy is required, reference should be made to the results in our paper "Protection Measurements of Lead Shielded Radium" (to be published).

Clinico-Pathological Conference

ST. LOUIS UNIVERSITY SCHOOL OF MEDICINE

E. Lee Shrader, M.D., L. R. Sante, M.D., and W. A. D. Anderson, M.D.

HISTORY AND CLINICAL EXAMINATION

E. Lee Shrader, M.D.

A twenty-one-year-old white female entered the hospital on Feb. 4, 1943, complaining of abdominal pain which had its inception on Jan. 25, 1943. The pain at first involved the right lower quadrant and occurred chiefly in the evening but was sufficiently relieved by a hot-water bottle to permit sleep. Two days later, Jan. 27, it became more generalized and was associated with cramping and tenderness. No fever was present and the white count and differential count were normal. Purgative and an enema, with bed rest, enabled the patient to return to work. On Jan. 31, she again had recourse to an enema for relief. On Feb. 3, she was seen by a physician and a gastro-intestinal x-ray examination was ordered. The pain at this time was colicky in nature and radiated to the back. On Feb. 4, her illness became so pronounced that she remained in bed. Syntropan and papaverine were administered. Emesis occurred for the first time on the evening of Feb. 4. The temperature was normal on admission.

Physical examination on admission showed the patient to be well nourished and well developed, in no acute distress. The findings were as follows:

Head: No evidence of pathological involvement.

Eyes: Pupils round, regular, and equal, reacting to light and accommodation; external ocular movements normal; no nystagmus; conjunctivae and sclerae appeared clear.

Nose and Ears: No abnormality.

Mouth: Excellent hygiene; mucous membrane well colored; tonsils not prominent; oropharynx not abnormal.

Neck: No lymphadenopathy or goiter.

Chest: Normal to inspection, palpation, percussion, and auscultation; diaphragm

high on right side extending to 7th intercostal space posteriorly.

Heart: Contour and position normal; rate regular; blood pressure 118/68. A systolic murmur was present, loudest in the second intercostal space to the left of the sternum.

Abdomen: Full below the umbilicus but not tense and showing no rigidity. The point of greatest tenderness was in the mid-line between the umbilicus and pubis. A vaguely palpable mass about 5 cm. in diameter was present in the right lower quadrant; not freely movable and fairly tender. Tenderness was also noted on the left side in the lower quadrant. Normal peristaltic sounds were heard on auscultation. No inguinal lymphadenopathy was present.

Skin: No eruption or abnormality.

Extremities: Normal appearance.

Neuromuscular System: Achilles jerks present; no ankle clonus; plantar reflexes normal.

On Feb. 5, other examiners described the abdominal growth as in various locations, differing greatly in size and consistency, and giving widely different impressions as to its cause, such as ovarian cyst or twisted pedicle cyst. One examiner described the consistency of the mass as "that of old blood" and suggested the possibility of ruptured graafian follicle.

ROENTGEN EXAMINATION

L. R. Sante, M.D.

Roentgen examination of the gastro-intestinal tract was made on Feb. 5, 6, and 7. The esophagus, stomach, and duodenum did not show any evident abnormality. Hourly examinations were made of the passage of the opaque meal through the small bowel. No abnormality was noted until the three-hour examination, when unusual appearing intestinal loops were encountered in the lower portion of the abdomen. By the four-hour examina-



Fig. 1. Large circular loops of ileum, of increased caliber but uniform in size and devoid of mucosal markings. The inner border was smooth and an unbroken column of barium extended throughout this segment. No peristalsis was seen in this segment and barium mixture was forced slowly through it by pressure from above.

tion these had acquired definite characteristics (Fig. 1). Several large circular loops of small intestine were seen, much wider in caliber than normal intestine but uniform in size and devoid of mucosal markings, showing a perfectly smooth inner border and an unbroken column of barium through the entire extent of the region of involvement. There was no constriction at any place in the involved intestine or distal to it; no evidence of a "string sign." The barium mixture moved slowly through these distended loops by pressure from above, not by peristaltic action; once beyond the involved region, it seemed to pass more rapidly onward into the colon. The lesion was obviously not caused by intestinal obstruction from mechanical ileus of any sort nor by any granulomatous process filling the lumen. The thickened palpable loops of bowel, their circular contour, the loss of mucosal pattern, uniform enlargement in caliber, and lack of peristaltic action gave the impression of an infiltrating process invading the entire thickness of the wall of the intestines. Such a

condition has been described in malignant infiltration of the intestinal wall, especially lymphosarcomatous involvement.

On Feb. 13 a cystoscopic examination was made but the ureteral catheters could not be introduced much above the ureterovesical junction. It was observed, however, that the bladder wall was pressed inward from above by some extrinsic mass.

OPERATION

On Feb. 15 the peritoneal cavity was opened by Dr. John W. Stewart. The cecum, appendix, and entire ascending colon were indurated and fixed. The mesentery was thick and large nodes were present. The process extended backward 24 inches on the ileum, in which area the bowel wall was indurated. An enterocolostomy was performed.

LABORATORY PROCEDURES

The blood counts on successive occasions were as shown. The bleeding time was 30 seconds; clotting time 1 minute 35 seconds.

Feb. 6: NPN 32. Blood sugar 80. Kahn and Kline tests negative.

Feb. 12: Cystoscopic bladder urine showed occasional leukocytes, epithelial cells.

Feb. 17: Urine culture: gram-negative bacilli; gram-positive bacilli; gram-positive diplococci.

Feb. 22: Heterophile antibody test negative.

Feb. 19: Sulfathiazole level 1 mg.

March 1: Total plasma proteins, 6.3 mg. per cent. A 4.1. G 2.2.

March 21: Total plasma proteins, 6.4 mg. per cent A 4.4. G 2.0.

March 23: Blood chlorides 346 mg. per cent.

POSTOPERATIVE COURSE

The patient ran a stormy postoperative course, with nausea, vomiting, abdominal distention, and fever ranging from 102 to 103.4°, with pulse as high as 120 and respiration 28.

On the basis of the clinical diagnosis of lymphosarcoma, palliative x-ray therapy

BLOOD COUNTS ON SUCCESSIVE OCCASIONS

Date	White Cells	Red Cells	Juvenile Cells	Stabs	Segmented	Neutrophils	Eosinophils	Basophils	Mono-cytes	Lymphocytes	Lymphoblasts
2-6	7,300	4.0	..	26	52	78	2	1	5	14	..
2-12	4,950	...	4	23	25	48	1	..	15	30	..
2-18	7,000	4.3	6	54	14	74	..	1	15	9	..
2-19	7,150	4.4	..	39	29	68	1	..	15	16	..
3-1	6,700	4.4	2	20	30	50	..	..	24	24	..
3-14	10,200	3.8	2	11	9	22	..	..	6	18	52
3-21	72,000	3.0	..	2	6	..	..	..	2	73	17

was started but had to be abandoned after a few treatments owing to the extremely critical condition of the patient. This continued to become worse until death on March 24.

PATHOLOGICAL REPORT OF AUTOPSY
EXAMINATION

W. A. D. Anderson, M.D.

The body was that of a well developed but emaciated white female, with fairly advanced rigor mortis and a slight degree of livor mortis. The abdomen showed a recent midline suprapubic surgical scar extending to 4 cm. above the umbilicus. No tumors were evident on external examination, and superficial lymph nodes were not palpable. There was no peripheral edema.

No abnormalities of the pleural or pericardial cavities were evident. The peritoneal sac contained 200 c.c. of clear fluid of light yellow color. Several loops of small intestine were bound together by fibrinous bands, and the serosal surfaces of the bowel were dull and gray. The esophagus and stomach were unchanged, but the wall of the duodenum was thickened up to a maximum of 1.5 cm. This thickening was due to irregular and nodular accumulation of a soft grayish white tissue which seemed to involve mainly the submucosa and mucosa. The duodenal-jejunal junction and the proximal 12 cm. of the jejunum were similarly involved. The remainder of the jejunum and the proximal two-thirds of the ileum were unaffected. The distal third of the ileum and the appendix showed an irregular thickening up to a maximum of 1.5 cm., having an appearance similar to that in the duodenal

region. An intact enterocolostomy connected the ileum above the region where the thickening began to the transverse colon. In the thickened portions of the small intestine there was some corresponding narrowing of the lumen of the bowel, but ulceration was not a prominent feature.

The lymph nodes of the abdomen and pelvis were all enlarged up to a diameter of 2 cm. They were of soft consistency and uniformly grayish white on their cut surface. About the pancreas, kidneys, aorta, and iliac vessels, the enlarged nodes formed irregular conglomerate masses of soft grayish tissue.

The heart, blood vessels, and respiratory tract showed no abnormality, but there was some enlargement of the mediastinal lymph nodes. The liver weighed 1,760 gm. and showed a mottling of the light brown cut surface by small rounded areas of grayish tissue. The spleen weighed 225 gm. and its cut surface likewise showed a mottling by translucent grayish tissue. The kidneys each weighed 150 gm. and showed lobulation by masses of soft grayish white tissue in the cortex. These grayish areas were irregular in size and shape, and many showed coalescence. The remaining organs showed no gross abnormalities.

The gross changes in the various organs were found microscopically to be due to growth of a polymorphic lymphoblastomatous tissue. In the small intestine and appendix the neoplastic growth involved mainly the mucosa and submucosa, but in areas where there was greatest thickening of the wall, the mucosa was largely replaced, the muscularis was invaded, and

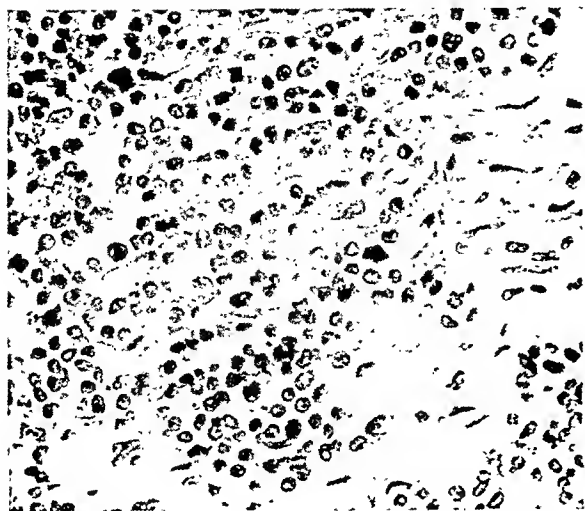


Fig. 2. Microscopic section from thickened wall of distended loop of ileum, showing infiltration of the muscular layer of the intestinal wall by lymphoid tissue.

the serosa involved (Fig. 2). The enlarged lymph nodes showed loss of their architecture and replacement by neoplasm, which in some areas had invaded through the capsule. The spleen similarly showed replacement of its normal tissue by tumor. In the kidneys, adrenals, and pancreas

there were focal infiltrations of lymphoblastomatous tissue, with crowding and atrophy of parenchymatous structures. A similar but lesser degree of involvement of bone marrow, ureters, ovaries, fallopian tubes, and uterus was found.

The neoplastic tissue was essentially similar wherever seen. It appeared to be of essentially lymphoid nature and exhibited marked polymorphism. Many cells were hyperchromatic. Uninuclear and multinucleated giant cells were common, many being of the Sternberg or Dorothy Reed type. Plasma cells were frequent but eosinophils were scarce and there was little or no tendency to fibrosis. Moderate numbers of mitoses were found.

Summary of Autopsy Findings: Lymphoblastoma of Hodgkin's sarcoma type, involving mainly the small intestine, appendix, spleen, and abdominal pelvic lymph nodes, with lesser involvement of the kidneys, adrenals, pancreas, bone marrow, ureters, uterus, fallopian tubes, and ovaries.



EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

Fluoroscopy and Leukemia

"That the practice of radiology entails certain hazards to health and life was forcibly impressed on its practitioners many years ago, but not until a large number of radiologists had suffered or died from radiodermatitis and cancer. . . . It was soon learned that this danger could be averted by the ordinary precautions which are now habitually employed. So effective are these methods in the prevention of skin lesions that the radiologist has apparently been lulled into a false sense of security from all harm. His serenity is not due to ignorance, but to an unwarranted optimism in the face of his abundant knowledge. He is fully aware that intact skin may cover a multitude of internal changes wrought by irradiation. These changes are the expected result of radiotherapy; they are found at the necropsy table, are substantiated by experiments on animals, and are demonstrated conclusively by the microscope and the test tube."

These words of caution uttered by Carman twenty years ago were occasioned by his study of the case of a prominent radiologist who had died of lymphatic leukemia. There was reason to believe that lack of adequate protection during a large volume of fluoroscopic work might have contributed to the development of the disease in this instance.

Since the presentation of Carman's paper, numerous investigators have attempted to determine the role of roentgen rays in the production of leukemia by submitting animals—chiefly mice—to whole-body irradiation. These experiments have demonstrated a greatly enhanced incidence of the disease in the treated animals—from

four to eight times that in unirradiated controls.

In this issue of RADIOLOGY Henshaw reports experiments in which mice were submitted to radiation of such intensity that damage could be produced in the blood-forming organs over a considerable period of time. The incidence of leukemia in these irradiated animals was almost 30 per cent, while in the control series it was only 7 per cent. There was a depression of the leukocyte count during the treatment period followed by a return to normal when irradiation was discontinued. In some animals the recovery extended into a leukocytosis, and in these leukemia invariably developed.

The results obtained from such experiments and the occasional occurrence of leukemia in those working with roentgen rays has prompted further studies to determine the role of radiation in the development of leukemia in man. In a recent study by Henshaw and Hawkins from the National Cancer Institute, the incidence of leukemia in physicians and in the general population was compared. It was found that leukemia was recognized approximately 1.7 times more frequently among physicians than among white males in the general population. This observation the writers point out does not necessarily indicate that radiation acted as the inciting agent. The significance of the findings lies in their accord with those demonstrated by animal experimentation.

An interesting study of leukemia in radiologists, by March, is presented in this issue of RADIOLOGY. He reports the death from leukemia of 8 American radiologists

during the past fifteen years, which would indicate that the incidence of the disease in radiologists is more than ten times as great as in other physicians during the same period. After calculating the probable error inherent in so small a series, March concludes that the observed increase is significant.

The danger of fluoroscopy to the operator has long been known and publicized, but too often attention has been given only to direct radiation, while the possibility of damage from secondary radiation has been neglected. The sources of stray radiation have been carefully studied by White, Cowie, and de Lorimier, and their conclusions deserve thoughtful consideration. They found a considerable escape of radiation from conventional "ray-proof" tubes and warn against over-confidence in such tubes, which usually require auxiliary protection. By far the greatest amount of secondary radiation, however, they attribute to the patient, and this is especially to be considered with the use of the horizontal fluoroscope. Built-in shields around such tables when combined with lead aprons give good protection. The area of the field also enters into consideration, as the secondary radiation from the patient is almost directly proportional to this factor.

Braestrup has also studied the matter of stray radiation in diagnostic radiology—particularly fluoroscopy—and has pointed to the need of a periodic check on the stray radiation received by the radiologic personnel. Of the three factors to be taken into consideration—equipment, structural shielding, and operating procedures—he considers the last by far the most important. Unless the roentgenologist gives his continued attention to this phase and has his staff do the same, it is not possible to secure satisfactory x-ray protection.

The possibility of administering a sizable dose of radiation to the patient must also be considered. Bell, who calculated

this dose with various field sizes and target-skin distances, cautions that dosages may sometimes be administered to the gonadal tissue which may lead to hereditary changes in the offspring. The effect on the skin, especially when the examination is repeated and when in addition multiple films are made of the gastro-intestinal tract, may be considerable, and the amount of radiation received may approach an erythema dose.

It would appear trite to warn radiologists of the dangers of fluoroscopy but, when consideration is given to the effect on the skin, the germ cells, and the hematopoietic system, it is easily appreciated that the matter cannot be over-stressed. Too often we are guilty of neglect of the simplest rules of protection, thus directly endangering our own health and that of our associates. The period of fluoroscopic observation should be kept as short as possible consistent with obtaining the desired information. As a further check a fluoroscopic timer should be installed to guard both the radiologist and the patient. Gloves and an apron of proved ray-proof material should invariably be worn.

The papers cited above and many others attest to the interest which has been aroused among radiologists and biologists in possible injury to the blood stream and internal organs from the careless or overzealous use of radiation. It behooves us as radiologists to take the lead in applying the indicated safety measures.

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ANNOUNCEMENTS AND BOOK REVIEWS

NEW ENGLAND ROENTGEN RAY SOCIETY

At the last annual meeting of the New England Roentgen Ray Society, the following officers were elected: President, Dr. Hugh F. Hare, Lahey Clinic, Boston, Mass.; Vice-President, Dr. Philip Batchelder, Providence, R. I.; Secretary-Treasurer, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass.

SECTION ON RADIOLOGY AMERICAN MEDICAL ASSOCIATION

At the annual meeting of the American Medical Association, the Section on Radiology elected the following officers: Chairman, Dr. Edwin C. Ernst, St. Louis; Secretary, Dr. U. V. Portmann, Cleveland; Representative to the American Board of Radiology, Dr. John W. Pierson, Baltimore; Delegate to the House of Delegates, Dr. B. R. Kirklin, Rochester, Minn.; Executive Committee, Dr. Edwin C. Ernst, Dr. Raymond C. Beeler, Indianapolis, and Dr. Robert A. Arens, Chicago.

ELECTION OF DR. E. U. CONDON TO THE NATIONAL ACADEMY OF SCIENCES

Dr. Edward U. Condon, Associate Director of the Research Laboratories for the Westinghouse Electric and Manufacturing Company, has been elected to membership in the National Academy of Sciences. Doctor Condon is especially known among radiologists for his interpretation of the phenomenon of spontaneous emission of alpha particles from such materials as radium, his theory being developed jointly with Dr. R. W. Gurney, formerly associated with him at Princeton University, now of the faculty of the University of Bristol, England. The deeper understanding of radioactivity provided by their studies paved the way of much of the more recent work in nuclear physics.

LOWELL S. GOIN, M.D. PRESIDENT, CALIFORNIA MEDICAL ASSOCIATION

Dr. Lowell S. Goin, of Los Angeles, Chairman of the Board of Directors of the Radiological Society of North America, has recently taken office as president of the California Medical Association. RADIOLOGY extends its congratulations to Doctor Goin and to the society that will benefit by the qualities of leadership which he brings to his new office.

Books Received

X-RAY EXAMINATION OF THE STOMACH. A DESCRIPTION OF THE ROENTGENOLOGIC ANATOMY, PHYSIOLOGY, AND PATHOLOGY OF THE ESOPHAGUS, STOMACH, AND DUODENUM. By FREDERIC E. TEMPLETON, M.D., Head of the Department of Roentgenology, The Cleveland Clinic. A volume of 516 pages, with 287 reproductions of x-ray plates. Published by the University of Chicago Press, Chicago, Ill. Price \$10.00.

Book Review

UROLOGICAL SURGERY. By AUSTIN INGRAM DODSON, M.D., F.A.C.S., Richmond, Virginia, Professor of Urology, Medical College of Virginia; Urologist to the Hospital Division, Medical College of Virginia; Urologist to Crippled Children's Hospital; Urologist to St. Elizabeth's Hospital; Urologist to St. Luke's Hospital and McGuire Clinic. With Contributions by R. A. BERGER, M.D., F.A.C.R.; DOUGLAS G. CHAPMAN, M.D., F.A.C.P.; EVERETT IDRIS EVANS, Ph.D., M.D.; FRED M. HODGES, M.D., F.A.C.R., MAJOR GUY WINSTON HORSLEY; LINWOOD D. KEYSER, M.D., F.A.C.S.; LAWRENCE O. SNEAD, M.D., F.A.C.R. A volume of 768 pages, with 576 illustrations. Published by the C. V. Mosby Company, St. Louis. Price \$10.00.

The author states in his preface that this book is intended as a "surgical supplement to the excellent books on the principles and practice of urology now in use." It is based on his own wide experience, but he has given much space to the experience of others, as reported in the literature.

He has divided his subject anatomically and treats methodically of the surgical treatment of the kidneys, ureters, bladder, urethra in both sexes, and the male external genitalia. Particular attention is given to the subject of plastic surgery of hydro-nephrosis, nephroptosis, and urethral anomalies. The book is well illustrated.

A rather unusual feature is the inclusion of chapters by contributing authors on excretory urography, radiation therapy, anesthesia, blood transfusion, endocrinology, and a long one on acid base balance and fluid administration. Dr. Lawrence O. Snead contributes the chapter on Urography and Cystography and Dr. Fred M. Hodges that on Radiation Therapy.

This is a valuable book for the surgeon, for whom, of course, it is designed. The radiologist will find it of less specific value.

IN MEMORIAM

JOHN T. MURPHY, M.D.

Aug. 15, 1885-June 15, 1944

The *Toledo Times* of June 16, 1944, carried as the caption to its leading editorial "The World Has Lost a Great Physician" and stated in the closing sentence: "His life represents a great and permanent stride in the march of medicine toward its goal—to heal and comfort the sick."

The hundreds of personal friends and thousands of acquaintances of John Thomas Murphy will agree with these and many other tributes carried in that editorial. Murphy, in Radiology, was a national and international figure. And yet, the home town knew him best. At the end of life's span no tribute can quite compare with the simple expression of appreciation from the folks at home.

In and out of medicine John Murphy was known as a keen, progressive, professional gentleman, as a true physician, and as a brilliant and witty Irishman, upholding the best traditions of the Irish-American. To most of his friends and acquaintances he was either John or Murphy. The warmth of his personality was such that it could not be otherwise. His cordiality helped many a young man over the rough spots of the early years. In Radiology, a reference to, simply, "Murphy" left no confusion or uncertainty—"Where McTavish sits, there is the head of the table."

Murphy has completed a successful life: the success has been due largely to hard work, an unusually deep interest in people and a magnificent loyalty in friendships.

Doctor Murphy was graduated from the Medical College of the University of Toledo in 1906 and followed this with a varied postgraduate training in which pathology played an important part. This early interest carried through to be a factor of influence in some of the best work of his later years. From 1917 until the time of his death he was Director of the Department of Radiology of St. Vincent's Hospital, Toledo, as well as Consultant to other local hospitals.

A review of his writings is of interest in that it shows a trend from diagnostic subjects to therapy. His greatest contribution—the diagnosis of bone tumors—was stimulated by therapeutic experiences.

This work on bone-tumor diagnosis calls for special mention because of its basic and fundamental importance, even though it is already widely known by reason of several national awards and many popular presentations in teaching courses before the various societies. But while the list of his contributions to the literature is substantial, it is in no way comparable to his direct contribution of personality in teaching.

Doctor Murphy was a member of all of the national radiological societies and had been honored by most of them. He was a Diplomate of the American Board of Radiology from its initial session in 1934. He was Secretary of the Section on Radiology of the A. M. A. from its establishment in 1931 until his death. He was Secretary of the American Roentgen Ray Society in 1928-31 and its President in 1934. He was President of the American College of Radiology in 1935.

Those who knew John Murphy best realized the effort necessary to the carrying on of so many public spirited enterprises within the field of Radiology in addition to the management of a large hospital service and a very active private practice. He never complained of his painful physical disabilities. Hard work in his extra-professional life seemed to balance his professional load. As a young man he excelled in track work and figure skating and was an outstanding amateur photographer. He devoted much time to flying when the airplane was still a "crate." When flying became safe and commonplace, he grounded himself and later became one of the leading figures in the establishment of Toledo's Civil Aeronautics Reserve Corps. His figure skating and fast motor-boating he carried on with to the last.

Doctor Murphy's interest in the problems of general betterment in society led to an active support of the Public Forum in Toledo, an organization which attracted outstanding talent to its platform for years.

This very full life has been terminated at the time of its maximum productivity. It will carry on with us, however, as a permanent monument of inspiration. Radiology pays tribute to a great physician, a loyal friend, and a grand Irishman.

DOUGLAS QUICK, M.D.





JOHN THOMAS MURPHY, M.D.

1885-1944

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please co-operate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

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Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

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The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

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Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

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Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

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The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh 24, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

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Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

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Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Aero-Otitis Media: A Roentgenologic Study. J. C. Larkin. *Am J. Roentgenol.* 51: 178-185, February 1944.

Aero-otitis media is the name applied to a condition which may develop when the air pressure in the tympanic cavity is not equal to the pressure in the external auditory meatus and posterior nasal pharynx. This inequality of pressure results in a collapse of the tympanic membrane against the labyrinthine wall of the internal ear and a shift of the auditory ossicles. This usually is followed by congestion and inflammation of these structures and there may be hemorrhage into the tympanic membrane. Hearing may be lost for a few hours or even days. The condition is rather common among the hundreds of thousands now engaged in aviation.

For roentgen examination of the structures involved, the author recommends a modified vertico-submental view, similar to that used for examination of the sphenoidal sinus. If lipiodol is injected into the external canal, the anatomic outlines of this structure can be recognized and thus the position of the tympanic membrane can be distinguished. It has been found that the ossicles of the ear lie above and lateral to the central portion of the tympanic membrane. These structures are not always demonstrable on roentgenograms, however, so that their presence or absence is of no clinical value, and it is only when the right and left sides can be compared that the examination yields useful information. Shifting in position of the ossicles indicates a shifting of the tympanic membrane, although this has not been found to be an absolute criterion for aero-otitis media. However, blurring of the shadows of the ossicles due to congestion and the accumulation of exudate in the tympanic cavity and surrounding air cells has shown a correlation with the clinical findings, and these roentgen changes can be relied upon to indicate aero-otitis media.

L. W. PAUL, M.D.

THE CHEST

Pneumoconiosis: Story of Dusty Lungs. Lewis Gregory Cole. *Am J. Roentgenol.* 51: 125-177, February 1944.

This article is an abstract of material which has been published elsewhere in book form. In it the author presents the results of his researches on pneumoconiosis. A good deal of the discussion is given over to the pathologic aspects of this condition and in this respect some of the author's observations are at variance with the published reports of others. Thus, his observations indicate that the dense areas in the lungs which cause roentgen shadows in cases of pneumoconiosis are not due to connective tissue but are caused by dust, dust-laden phagocytes, and collagen, either in the alveoli or in the pulmonary stroma. This finding is of some interest, since in chronic inflammatory and tuberculous lesions of long standing, connective tissue develops which contracts and deforms the thoracic cage, whereas massive accumulations of collagen, no matter how old, do not do this.

On the basis of roentgenologic and pathologic findings, six separate types of pneumoconiosis can be recognized.

(1) *Peribronchial Perivascular Pneumoconiosis*: This term was first applied by Pancoast, but later workers have looked upon it with disfavor. The author believes, however, that Pancoast was correct and that there is such a type of silicosis which can be recognized. In this lesion the inhaled dust lodging in the alveoli is engulfed by phagocytes and carried through the lymph channels paralleling the blood vessels and bronchi, either toward the hilum or toward the pleura. Some of these phagocytes become blocked in the lymph channels at the hilum, and others are dammed back into the lymph channels paralleling the larger and medium-sized bronchi. This causes deposition of collagen in laminae around the larger and medium-sized blood vessels and bronchi. The roentgen findings consist in increased density of the lungs, usually bilateral, relatively symmetrical, and often accompanied by increased opacity at both bases and perhaps at both apices. The hilum shadows are increased and may be circumscribed or may radiate out along the blood vessels and bronchi.

(2) *Vesicular Pneumoconiosis*: In this type the dust-laden phagocytes and small strands of collagen are laid down in the lymph channels surrounding the smaller blood vessels, bronchioles, and terminal lung lobules. The roentgen findings are evidenced by a bilateral, relatively symmetrical diffuse mottling with a pattern not so clear cut and well defined as a silicotic nodule. These roentgen findings are by no means new. They have been described as fine nodulation, ground-glass appearance, antepriamary, etc.

(3) *Nodular Pneumoconiosis*: In this form, roentgenograms show a bilateral symmetrical nodulation in which the nodules are sharp and clear-cut with no relationship to the blood vessels and bronchi. These nodules are composed of collagen laid down like the layers of an onion, and adult nodules contain very little dust. This type of lesion is slow in developing and patients are often free of symptoms even when the lungs are filled with nodular foci.

(4) *Chronic tuberculoid pneumoconiosis* looks like tuberculosis but is not caused by the tubercle bacillus. The dust-laden phagocytes congregate in an alveolus or in adjacent alveoli and together with collagen form small, irregularly spherical masses that correspond in size and shape to the pulmonary tubercles of acid-fast bacillus origin. The roentgen findings may simulate tuberculosis very closely. The lesion is usually bilateral, by no means symmetrical, and often there are large dense areas in one or the other apex and infiltration of various-sized nodules in the opposite mid-lung field.

(5) *Cystic Pneumoconiosis*: In this form the bronchioles leading to the terminal lung lobules become occluded by masses of collagen or dust-laden phagocytes. This causes a valve-like action which allows air to enter the terminal lung lobule but does not allow its exit, resulting in an air cyst. In the roentgenograms this produces ring-like shadows encircling darker areas, the direct antithesis of the nodular type, which is manifest roentgenographically by white spots on a dark background. These lesions are bilateral; often they are not as symmetrical as the first three types, and the cystic appearance predominates.

(6) *Parenchymal pneumoconiosis (acute silicosis)*

includes (a) acute pneumonic parenchymal and (b) acute tuberculoid pneumoconiosis. In the first form the roentgen findings are a diffuse generalized haze or cloudiness involving both lung fields, usually bilateral but not symmetrical. There may be localized patches of increased density that suggest more advanced degrees of consolidation. Distinct nodulation is usually absent. Acute tuberculoid pneumoconiosis simulates acute miliary tuberculosis. The social and economic problems of this form of the disease are especially serious, because of their rapid development and because the lesion may not be recognized as silicosis.

L. W. PAUL, M.D.

Radiological Appearances in the Development of Coal Miners' Pneumoconiosis. E. A. Aslett, T. W. Davies, and T. I. Jenkins. *Brit. J. Radiol.* 16: 308-313, October 1943.

Thirty-one coal miners who were known to have silicosis were re-examined after three and a half to four and a half years. Comparison of the films shows that simple nodulations may become coalescent. In advanced cases a streaky fibrosis occurs which may be a factor in the development of emphysema. This fibrosis also aids in drawing the nodules together to form increasingly dense lesions.

Tomographic studies, made in 4 cases, indicate that the disease may be more extensive than is apparent in plain films.

SYDNEY J. HAWLEY, M.D.

Radiologic Evidence in Haematite Iron-Ore Workers. Richard Fawcitt. *Brit. J. Radiol.* 16: 323-330, November 1943.

Hematite itself is opaque to x-rays and its presence in the lungs may result in a fine flake-like mottling. Some hematite miners, especially those working in dry mines and those which have a high silica content, show a progressive fibrosis indistinguishable from silicosis.

SYDNEY J. HAWLEY, M.D.

Occupational Disease of the Lungs in Boiler Scalers. Lasar Dunner. *Brit. J. Radiol.* 16: 287-290, October 1943.

Boiler scalers may show a nodular infiltration in the lungs similar in appearance to miliary tuberculosis and silicosis. The clinical symptoms and physical findings are not characteristic. The diagnosis depends upon the roentgen picture and the occupational history.

SYDNEY J. HAWLEY, M.D.

Atypical Pneumonia of Unknown Etiology: A Clinical, Roentgenological, and Pathological Correlation. Frank B. Lusk and E. Kenneth Lewis. *Dis. of Chest* 10: 19-40, January-February 1944.

Five hundred patients representing a cross section of some 6,000 cases of acute epidemic respiratory tract infection seen in the Station Hospital at Fort Custer, Michigan, from Dec. 1, 1942, to June 1, 1943, constitute the basis of this paper. In 60 per cent of these the infection cleared without pulmonary involvement; in 15 per cent a diagnosis of bronchitis was made; in 25 per cent there were roentgen evidences of pneumonia.

The authors are of the opinion that atypical pneumonia is not a clinical entity *per se*, but one phase of a generalized disease. From the clinical and roentgen evidences they divide the generalized infection into four stages: bronchitic, peribronchitic, alveolar, and

broncho-alveolar. Of these, all but the first present more or less characteristic roentgen findings. The peribronchitic stage shows "increased size of the hilar shadows" and "increased density of the trunkal markings radiating as shafts toward the diaphragm." The alveolar stage is represented roentgenographically by "(a) the small irregular, slightly opaque shadow or shadows lurking among the thickened bronchi; (b) that well-circumscribed or ill-defined shadow, soft, fleecy, ground-glass in appearance, which spreads out fan-like from the hilus, or which hangs unsuspended here and there throughout the lung fields; (c) that extensive lesion which, occupying the greater part of a lobe, reaches out toward the periphery or the interlobar pleurae." In the broncho-alveolar stage the appearance is one of "diffuse mottling" or "small, denser, tapioca-like granules, confined to the bases, adjacent to the increased trunkal markings or scattered throughout the parenchyma."

Five photomicrographs are included from a fatal case of recurrent atypical pneumonia complicated by an acute nephritis plus a superimposed bacterial pneumonia.

An attempt is made to correlate the clinical, roentgenological, and pathological findings.

HENRY K. TAYLOR, M.D.

Benign Nontuberculous Bronchial Stenosis. Herbert W. Schmidt. *Arch. Otolaryng.* 39: 43-52, January 1944.

Benign non-tuberculous bronchial stenosis is a rather common complication of infections of the respiratory tract but it is rarely recognized. There is usually a history of antecedent pneumonia, severe tracheo-bronchitis, or repeated seizures of asthmatic bronchitis. After variable periods, recurrent bouts of chills, fever, and general malaise develop. The period of fever is usually preceded by an irritating, non-productive cough. The temperature may reach 102-103° F. and persist for two to seven days, at the end of which time a purulent secretion is coughed up. This relieves the symptoms.

The lower lobe of the right lung is more likely to be the site of a benign non-tuberculous bronchial stenosis than the upper or middle lobes. Physical findings may be absent, since the stenosis usually involves the third division of a bronchus. When present, they are usually those of obstructive atelectasis, namely, dullness on percussion and decrease in breath sounds over that portion of the lung supplied by the involved bronchus.

Roentgen examination is important in determining the presence of atelectasis, but does not always indicate whether or not a bronchus leading to the affected region is open or closed. In obstructive atelectasis, the pulmonary field is reduced; the heart and mediastinum are displaced toward the affected side; there may be narrowing of the intercostal spaces with increased downward inclination of the ribs; the diaphragm is elevated and shows decreased motion on the side of the lesion. The atelectatic region itself will show increased density.

In cases of valvular obstruction with emphysema the roentgenograms show increased transparency of the involved side. The diaphragm is depressed and partially fixed. The mediastinal structures are displaced from the affected side. There is increased movement of the diaphragm on the opposite side.

Bronchography may help in determining the site of an obstruction, if one exists.

Bronchoscopy is the only clinical method of diagnosing a benign bronchial stenosis and is the only satisfactory way of treating such a lesion, dilatation producing favorable results in about 66 per cent of cases. It should not be carried out, however, for two or three weeks after an acute attack in suspected cases. If the patient is suffering from chronic asthmatic bronchitis, the bronchial mucosa is inflamed and variable amounts of secretion—mucoid, mucofibrinous, or mucopurulent—are present on both sides. The stenotic bronchus is almost always a branch of one of the bronchi supplying the lower lobe. The mucous membrane around the orifice is inflamed and edematous. The normal diameter of the orifice may be reduced to a sixth or a fourth, or the bronchus may be completely closed, and there is no change in size with inspiration and expiration. Usually there is a trickle of purulent secretion coming from its orifice. If the bronchus is dilated, bloody mucopurulent material comes from its depths. The bronchus bleeds more readily when touched than a normal bronchus. At times it is difficult to be certain that the lesion is not a cancer and a biopsy is advisable.

The findings in 25 cases of benign non-tuberculous bronchial stenosis are reviewed, and 4 cases of particular interest are reported in detail.

Right-Sided Aortic Arch. Report of a Case. Harold J. Isard. U. S. Nav. M. Bull. 42: 168-171, January 1944.

The author reports a case of right-sided aortic arch. This finding was purely coincidental and was established by fluoroscopy, at which time the trachea and esophagus appeared deviated to the left and anteriorly, while the aortic knob was present to the right of the mid-line.

ELLWOOD W. GODFREY, M.D.

THE DIGESTIVE SYSTEM

Kymography and Its Application to Esophageal Movement. John W. McLaren. Brit. J. Radiol. 16: 270-273, September 1943.

Kymographic studies of the esophagus with the aid of a thick paste of barium were made. By enlarging the tracings and reconstructing the movements of the whole esophagus from these enlargements, it is shown that there is a regular constricting wave which passes down the esophagus after swallowing. There is no evidence that this is preceded by a zone of relaxation. Liquids appear to fall rapidly down the tube.

SYDNEY J. HAWLEY, M.D.

Peptic Ulceration of the Esophagus with Partial Thoracic Stomach. A. S. Johnstone. Brit. J. Radiol. 16: 357-361, December 1943.

A study of 7 cases shows that peptic ulceration occurs chiefly in older patients and in patients with congenitally short esophagi or hiatal herniae. Hiatal herniae are more frequent in older people.

Frequent regurgitation of acid gastric contents is probably the precipitating cause of ulceration when the anatomical defects are present. When the ulcers are chronic, scar tissue develops which, when it contracts, may increase the hiatal hernia or the shortness of the esophagus, setting up a vicious cycle.

In an addendum the author refers to the "original article," written in collaboration with Allison and Royce (Allison, P. R., Johnstone, A. S., and Royce, G. B.; J. Thoracic Surg 12: 432, 1943. Abst. in Radiology 42: 94, 1944), reporting 10 cases (including the 7 mentioned above) of short esophagus with peptic ulceration. Eleven additional cases have now been seen.

SYDNEY J. HAWLEY, M.D.

Malignant Tumors of the Stomach. Felix de Amesti. Am. J. Surg. 63: 78-85, January 1944.

Of 127 patients with malignant gastric tumors admitted to Surgical Section "B" of the Hospital del Salvador, Santiago, Chile, from 1938 to 1942, 104 were subjected to operation. Sixteen patients refused operation; 7 were considered inoperable. In 98.55 per cent of the cases the tumor was found on histologic examination to be a carcinoma; in 1.44 per cent, a lymphosarcoma. Seventy-four per cent of the series were males. In the female, the greatest frequency of carcinoma was in the fourth and fifth decades; in the male, in the fifth and sixth decades. In over half of the cases, dyspepsia was the predominant symptom at the onset of the illness; when admitted to the hospital, however, the patient usually had a combination of symptoms. It was found that when the evolution of symptoms had covered more than a year the rate of operability was higher than in cases with a shorter history, probably due to the fact that in those with the longer history the neoplasm was of a less malignant character.

Roentgen examinations were done in 116 cases; gastric cancer was diagnosed in 109 of these. In 4 patients the diagnosis was not made at first but was established at a second examination following a gastroscopic diagnosis of cancer. Two patients were thought to have gastric ulcers; one, a degenerated gastric ulcer; two, pyloric stenosis; one, a benign gastric tumor; and one, an organic pyloric lesion.

Gastroscopy was performed on 49 patients, and led to a diagnosis of cancer in 46. In 37 cases a diagnosis of associated atrophic gastritis was made and this was confirmed by histologic examination.

The lesion was located on the lesser curvature of the stomach in 29.75 per cent of the cases; in the antropylic region in 29 per cent; in the cardiac end in 8.26 per cent; in the pylorus exclusively in 4.13 per cent; on the greater curvature in 1.65 per cent; and in the corpus in 2.47 per cent.

Forty-nine of the 104 patients operated upon had subtotal gastrectomies; 9, total gastrectomies. The operative resectability was therefore 56 per cent; the postoperative mortality in this group was 21 per cent.

The author presents survival statistics, but unfortunately only 38.43 per cent of the patients had been followed, and none for as long as five years. One patient who had a subtotal gastrectomy had survived for more than four years; 13 were alive from one month to two years following operation. One of the patients who had a total gastrectomy was alive and in good condition fourteen months after the operation.

Radiographic Findings in Idiopathic Steatorrhea. J. F. Brailsford. Brit. J. Radiol. 16: 283-285, September 1943.

For radiologic study of the small intestine in idiopathic steatorrhea, it is essential to take a series of

roentgenograms in the prone position, commencing immediately after ingestion of the barium suspension. With a watery suspension, the barium may not begin to pass immediately, but usually within fifteen minutes the greater portion of the jejunum can be demonstrated. This will present a normal appearance (uniform caliber; well defined, regular, smooth mucosal folds; a continuous column of barium) during the first thirty minutes. Thereafter the barium appears broken up into small curds or clumps. There is apt to be considerable hypermotility, the barium reaching the rectum before the stomach is empty.

The calcium metabolism is seriously disturbed in cases of idiopathic steatorrhea and this is reflected in the appearance of the bones. Radiographically these reveal a lack of compact cortex, though the outlines are sharp. The main trabeculae are parallel to the long axis of the bones and appear less closely packed together than normal. The metaphyses are greater in depth than normal and the outline of the diaphyses is blurred. The long bones tend to bend. The vertebral bodies show biconcave compression. The skull in the adolescent shows a fine stippled osteoporosis, while at a later age general decalcification may be associated with multiple ill-defined islands of varying size and density.

SYDNEY J. HAWLEY, M.D.

Diverticulitis of the Colon: Review of the Literature and an Analysis of Ninety-One Cases. Edward L. Young and Edward L. Young, III. *New England J. Med.* 230: 33-38, Jan. 13, 1944.

The incidence of diverticulosis of the colon is estimated at between 3 and 10 per cent. It is stated that 12 to 15 per cent of the cases progress to diverticulitis and that in about 15 per cent of patients with diverticulitis complications necessitate operation.

There are two types of diverticula: the congenital type, in which all the layers of the bowel wall are included, and the acquired type, which is a herniation of the mucosa through the muscular coat. The acquired type seems to be of mechanical origin, due to pressure in a bowel that is undergoing fatty degeneration of the muscle and loss of elasticity.

Diverticulitis is a disease of adult life; 95 per cent of the patients are beyond forty years of age, the highest incidence being in the fifth and sixth decades. It results from obstruction of the diverticular ostium, with edema and inflammation, which may progress to acute perforation of the bowel or develop into a pericolicitis. Either process may go on to a general peritonitis.

The symptomatology of diverticulosis is not characteristic. The classical picture of diverticulitis includes pain in the left lower quadrant, low-grade fever, slight leukocytosis, flatulence, some nausea, and irregular bowel habits, but not all of these symptoms need be present. As complications develop, the symptomatology becomes consistent with each. Thus, a sudden acute pain in the abdomen suggests acute perforation with peritonitis; a mass in the left lower quadrant indicates an indurated, thickened sigmoid or a localized abscess; obstipation may mean inflammatory and fibrotic closure of the sigmoid; sudden disappearance of a mass, relief of pain, and the appearance of pus from the urethra or rectum suggest perforation of an abscess with formation of a fistula.

Diagnosis is based on the history, physical examination, proctoscopy, and a barium enema study, the

last being the most valuable and accurate procedure. Diverticulitis is manifested by spasm, hypermotility of varying degrees, and occasionally by tenderness.

Treatment consists in establishing good bowel habits, with a low-roughage diet and mineral oil but no irritating cathartics. Rectal instillation of a dilute suspension of 30 gm. of x-ray barium in 90 c.c. of warm water, following a cleansing enema, twice weekly at first and later once a week, has given good results in the senior author's hands. Complications such as perforation and abscess formation must be handled surgically according to indications.

The authors report a series of 84 cases [not 91 as the title states] of diverticulitis of the sigmoid, of which 43 were chronic and 41 acute. In their observations they found the following facts of importance: Blood in the stool was found in 26 per cent of the cases where no other cause than the diverticulitis was found. The incidence of this condition was much higher in this series than in others, which suggests that in a true cross section of disease as seen by the general practitioner diverticulitis should be oftener recognized and treated. Conservative treatment, especially the use of x-ray barium either by mouth or, where possible, by rectum, gives a high percentage of relief. When surgery is needed, the simplest procedure possible is accompanied by the lowest mortality.

JOHN B. MCANENY, M.D.

THE SKELETAL SYSTEM

Solitary Eccentric (Cortical) Abscess in Bone. R. C. Brown and Ralph K. Ghormley. *Surgery* 14: 541-553, October 1943.

Solitary cortical bone abscesses give rise to a rather definite syndrome, pursue a regular benign course, without complication, and are susceptible to complete surgical eradication. They occur in both the long and the short bones, being characteristically placed, lying within, subjacent to, or superposed on, the cortex, occasionally in the neighborhood of an articulating surface. The exciting center of the lesion itself is minute, not exceeding a few millimeters in diameter as seen both at operation and in the roentgenogram. It elicits a variable mass of reaction, dependent seemingly upon the location with respect to the cortex and little affected by the age of the lesion.

Twenty-four patients with abscesses of this type were seen in a period of ten years (up to 1941) at the Mayo Clinic. The majority were distributed equally among the first three decades of life, with three in the fourth and fifth decades. The tibia and femur were the most common sites, accounting for 20 of the 24 cases. The lesion was also seen in the fibula, the radius, the os calcis, and the patella.

The clinical picture is that of a relatively mild but troublesome condition. Pain is the outstanding symptom, with a strong tendency to wax and wane. Exacerbations occurred commonly in changes of weather or with unusual exertion. The patient's localization of the pain is in most instances accurate to a high degree. Sharp pain often occurs at night, particularly among children. Nocturnal pain is more common as the disease process continues. Swelling, the next most common symptom, is more in the nature of a thickening and induration accompanied by redness and increased heat. In the series reported a limp was present when the abscess involved an area about a joint, as in the neck

or lower part of the femur, in the superior third of the tibia, and particularly in the os calcis and patella.

The chronicity of the complaint is striking. One patient had had pain for thirty-five years, another for twenty-seven, and a third and fourth for ten and nine years, respectively.

Roentgenologically the minute exciting lesion is characteristically seen, radiolucent, located within or beneath the cortex, but most commonly in the osteoplastic reactive portion of the periosteum. The authors agree with others that the lesions do occur within and on either side of the cortex. Reaction with osteosclerosis occurs about the lesions uniformly and is the pathognomonic element of the picture, especially its eccentric position. Relatively enormous elevation of the periosteum is seen with heavy densification. A question as to the presence of a Ewing tumor is usually settled by the visibility of the minute radiolucent area apparently in the center, geometrically speaking, of the reactive portion.

The treatment of these patients was not uniform. Fourteen were operated upon and obtained definite relief. One was given roentgen therapy and was much improved a year later. Another showed improvement both clinically and roentgenographically after a period of bed rest. Surgical excision is the procedure of choice, offering the best assurance of relief.

In spite of the fact that there was measurable fever in only one of the cases of this series, inflammation is believed to be the basis of the lesion. Nine of the patients gave a history of trauma, as a bump, a fall, a puncture wound, etc. Eight patients had a previous focal infection, such as chronic cervicitis, tonsillitis, a boil, or typhoid fever. In 10 cases microscopic examination of tissue removed surgically showed chronic inflammation. The fact that many of the cases had persisted for years is opposed to a neoplastic origin. One gets the impression of a small lesion being overwhelmed by a massive defensive mechanism apparently present in the region of the bone cortex.

J. E. WHITELEATHER, M.D.

"Stress" or "Fatigue" Fractures of Bone. J. Blair Hartley. *Brit. J. Radiol.* 16: 255-262, September 1943.

"Stress fractures," or "fatigue fractures," as the author prefers to call them, occur most frequently in the metatarsals, and after this, in order, in the tibia, femur, and fibula. They are rare in other bones. They are most common in adolescence and early manhood. Synonyms which have been used to designate fractures of this type are insufficiency fracture, overload fracture, wear-and-tear fracture, recruit's disease, periostitis ab exercitio, osteopathia itineraria, soldier's fracture, and pseudo-fracture. Actually, pseudo-fractures—Looser's "Umbauzonnen"—constitute a distinct entity. They invariably occur in diseased bone and are accompanied by little or no callus, while stress fractures involve otherwise normal bone and show rapid and abundant callus formation.

The clinical features vary with the stage of the malady. Pain, particularly on weight-bearing, is the chief symptom. This is relieved by putting the part at rest. The chief radiological indication is callus formation, usually at the site of the torque or point of greatest stress. As a rule, a small crack or fracture line may be demonstrated.

The cause of these fractures has been said to be a

nutritional deficiency or hypovitaminosis. While such a factor may be present, however, it can be shown that the fracture occurs at the point of greatest stress and is therefore probably mechanical in origin, even though there is no history of trauma. It is not true that stress fractures are always observed at the site of the nutrient foramina.

The treatment consists of rest for the affected bone. If the diagnosis is made early, a few weeks will suffice. If rest is not instituted, complete fracture may occur.

In the differential diagnosis the following must be considered: pathological fracture, congenital defects, general systemic disease, metastasis, primary bone tumors, Paget's disease, osteomalacia, rickets, tuberculosis, syphilis, osteomyelitis, and simple fracture due to violence.

SYDNEY J. HAWLEY, M.D.

Pathology, Clinical Manifestations, and Treatment of Lesions of the Intervertebral Disks. Albert Oppenheimer. *New England J. Med.* 230: 95-105, Jan. 27, 1944.

This is an extensive article discussing the development, cause, and pathology of changes in the intervertebral disks and their sequelae.

As the result of repeated traumata to the spine, the intervertebral disk seems to receive a greater amount of injury than the bone structure. The cartilage undergoes degeneration, with increased fibrosis, loss of turgor and volume. This results in flattening of the disk, narrowing of the intervertebral space, displacement of the articular processes, and narrowing of the neural foramen. Arthritic changes may appear at the zygapophyseal joints.

The clinical evidence depends upon the secondary changes rather than the primary injury and alteration in the intervertebral disk. The symptoms arise from the arthritic change and the compression of the nerve as it passes through the neural foramen. The signs and symptoms of this radicular neuralgia and neuritis are often indistinguishable from those of myalgia, peripheral arthritis, bursitis, and pain referred from diseased viscera.

The treatment is surgical or conservative. Conservative therapy consists chiefly in irradiation of the spine.

JOHN B. McANENY, M.D.

Fresh Fractures of the Carpal Scaphoid. Benjamin E. Obletz. *Surg., Gynec. & Obst.* 78: 83-90, January 1944.

Fractures of the carpal scaphoid occur almost exclusively in vigorous young men and are therefore frequently found in army training camps. The author bases his study on 45 consecutive cases seen during an eighteen-month period.

The carpal scaphoid has a constricted "waist," where most of the fractures occur. The majority of these bones have an adequate blood supply to both proximal and distal portions as demonstrated by arterial foramina along the entire length of the bone. Sometimes, however, there are no arterial foramina proximal to the waist, and in these instances a fracture through the waist could interrupt the blood supply to the proximal fragment.

In most cases the fractures are caused by a fall on the outstretched hands. The chief complaint is of a painful wrist, and this pain also limits movement. There is usually local tenderness but no swelling.

Roentgenograms of the injured wrist are made in four positions, all on a single 10 X 12-in. film, the usual anteroposterior and lateral views being supplemented by an anteroposterior view in ulnar deviation and a postero-anterior at 45 degrees oblique. With these additional views it is much easier to recognize the often almost invisible line of fracture at the time of injury. Once the diagnosis is made, subsequent serial roentgenograms are taken in the single ulnar deviation position. The author suggests that overexposure is a pardonable sin in these cases.

The fluids at the fracture site become acid from the 4th to the 7th day and cause absorption of the adjacent bone, the fracture line becoming wider and more apparent. There is also a reactionary hyperemia of the bones of the injured wrist during the first few weeks following fracture, which results in decalcification and osteoporosis of the wrist bones. The decalcification is usually mild, but may be severe, and because of the tendency to atrophy due to lack of use, recalcification may be delayed long after the usual two weeks of hyperemia is past, until healing permits renewed use of the wrist. Should the wrist be incompletely mobilized, the resulting irritation and trauma at the fracture site will greatly prolong the stage of hyperemia, and the decalcification will be more pronounced and of longer duration. Since decalcification is dependent on a state of hyperemia in the bone, interference with the arterial blood supply prevents loss of calcium in the affected area. Retention of normal calcium density, therefore, in a fractured bone is proof of its avascularity.

Since the carpal scaphoid is a cancellous bone, no subperiosteal callus is formed, and disappearance of the fracture line must be relied on to indicate healing. Persistence of the line beyond twelve weeks indicates delayed union.

If movement between the fractured surfaces is permitted by inadequate immobilization of the wrist, fibrous and fibrocartilaginous tissue will form at the fracture site while adjacent tissue becomes sclerotic and eburnated. This condition of non-union is indicated on the roentgenogram by a widened, translucent fracture line bounded on either side by a dense white margin.

The fractures studied by the author are divided into two groups, those with and those without interruption of the blood supply to the proximal fragment. Eight cases composed the former group.

Roentgenograms made at the time of injury show either an easily recognized fracture or a hair-line fissure which is barely visible. There is usually no displacement of the fragments. The scaphoid and the adjacent bones show a uniform and normal density. Three or four weeks after injury the fracture line is more distinct and there is a diffuse homogeneous decalcification of all the carpal bones, including both fragments of the damaged scaphoid if the blood supply has not been cut off. In those instances where the blood supply to the proximal fragment has been interrupted, there is no decalcification of that portion, and its original density remains unchanged; hyperemia is absent, and the absorption of calcium prevented.

Six to eight weeks after injury the general osteoporosis of the carpals is usually more pronounced in those cases with an interrupted blood supply, and as a result the dense proximal fragment is more noticeable. In these cases, too, the fracture line is still visible, while in many with normal circulation has disappeared.

At twelve weeks there is still a noticeable difference in density of the proximal fragment, but the fracture line now shows signs of healing in spite of the damage sustained by the blood supply.

At sixteen to twenty weeks, the relative density of the fragments is much less marked, and the fracture line has been obliterated by the healing process.

Removal of the cast will insure a return of normal calcium density to the carpal area within a few weeks, and subsequent roentgen examinations will disclose no degenerative processes in the scaphoid. It is evident that the dense white shadow of the proximal fragment is evidence of avascularity, not of aseptic necrosis. Bone cells die slowly when deprived of their blood supply and, since the avascularity of the fragment is temporary and soon relieved by vascular granulations bridging the fracture line, necrosis is entirely prevented. If the wrist is not properly immobilized, vascular bridging of the fracture line may be prevented, and necrosis of the fragment may result. The importance of proper immobilization is obvious. If it is complete, continuous, and maintained until healing has occurred, surgery will be unnecessary.

The author's method of treatment consists of a plaster-of-Paris gauntlet extending from the distal palmar crease to the elbow, including the proximal phalanx of the thumb. The wrist is fixed in a few degrees of dorsiflexion, the thumb in a relaxed position. The patient is urged to use his fingers freely, and his activity is not restricted. The cast is replaced if it breaks or softens and at the time of the serial x-ray examinations. In all the cases results were favorable as far as they could be ascertained. The average time of healing in cases without damage to the circulation was 8.3 weeks; with interruption of circulation in the proximal fragment 19 weeks were required on an average for complete disappearance of the fracture line.

D. W. TOWNSEND, M.D.

Subscapular Ossified Hematoma. Case Report. J. William White and Sydney Hunter. *Am. J. Surg.* 63: 124-130, January 1944.

The authors define a hematoma as a confined hemorrhage, in which clotting may or may not have taken place, which would include the hemorrhagic accumulations in serous cavities usually designated as hematoceles, hematomycysts, blood cysts, or more specifically as hemothorax, hemarthrosis, etc. Trauma is a common etiologic factor.

Small, uncomplicated hematomas are accompanied by few, if any, symptoms and tend to resolve quickly. Hematomas of larger proportions are symptomatic, although they may be concealed by more obvious and serious lesions. Collections of blood which are not successfully evacuated pass through phases similar in some respects to the process of tissue repair, i.e., resolution, fibrosis, suppuration, or, in rare instances, ossification.

Ossification occurs with greatest frequency in hematomas about the elbow joint and in the thigh. Often manifested as a later transition product, calcium deposits have been demonstrated roentgenographically early in the third week following injury. Serial x-ray films of ossifying hematomas show a progression from flocculated calcium islets to complete replacement by lamellations of compact and cancellous bone. Eventually, the inflammatory barrier found at the periphery of a hematoma is converted into a neomembrane,

grossly resembling periosteum and serving as a capsule at the circumferential limits of ossification.

The case recorded here occurred in a soldier, who complained of a "lump in the right shoulder, with numbness and tingling of the right hand." Twenty-two years previously he had sustained a severe crushing injury of the right shoulder. Treatment was promptly instituted; a plaster jacket was worn for three months, followed by physiotherapy in an effort to relieve persistent numbness in the hand. A cock-up splint was applied to the forearm and hand and this was maintained for a year and a half. A sensory disturbance persisted, but a swelling above the clavicle and in the axilla was not discovered until several years after the injury. This tumefaction was not believed to have increased in size over a period of fourteen years.

The patient continually supported his right hand in the opposite palm and maintained the arm at a 20-degree angle of abduction. The vertebral border of the corresponding scapula was rotated posterolaterally. Pain, which radiated along the ulnar surface of the arm and forearm, was induced by elevating the arm above the shoulder level and by elevating the chin forcibly while the head was rotated toward the side of the lesion. An obliquely directed ovoid, non-tender, solid, regularly surfaced tumor, movable vertically, medially, and laterally within narrow limits, occupied the right subscapular, axillary, and supraclavicular fossae.

Stereoscopic x-ray films showed a large irregular calcified mass measuring 14×6 cm. between the scapula and thoracic wall. This mass was sharply demarcated from the surrounding soft tissues and was not attached to any bony structure, although the upper four ribs were flattened against the lateral lung surface, thus narrowing the costal cage, and the scapula was moderately displaced backward. A tangential view after the injection of 30 c.c. of diodrast into the median basilic vein showed satisfactorily the basilic and axillary veins. The axillary vein was displaced anteriorly and 1.5 cm. above the calcified mass.

On removal the tumor proved to be an ossified hematoma, measuring $13 \times 11.5 \times 5.5$ cm. and weighing 390 gm. The function of the arm was completely restored, although there was a tendency to hold the distal phalanges of all digits in partial flexion; the numbness and tingling were relieved.

The deformity of the ribs and displacement of the scapula in this case suggest a peripheral deposition of calcium which, as the mass increased in volume, compressed the relatively less fixed adjacent structures. Early involvement of the medial cord of the brachial plexus was assumed from the history of numbness, which persisted from the time of injury. Pain and tingling were of more recent origin and were probably due to a slowly progressive peripheral extension, involving the nerve trunk and producing mild, but increasing, vascular symptoms.

The primary objective in the treatment of ossified hematoma should be prevention. Rest, passive motion, heat, diathermy, and massage are of benefit in some cases. The optimum time for surgical intervention has not been clearly defined. Too early removal may result in recurrence or extension of calcification; too late, in permanent pressure damage to adjacent vessels and nerves. The authors recommend waiting a year before making an attempt to excise an ossified hematoma, provided relief from neurovascular symptoms is not more urgent.

Two Congenital Deformities of the Tibia: Congenital Angulation and Congenital Pseudarthrosis. E. Rohan Williams. Brit. J. Radiol. 16: 371-376, December 1943.

Congenital angulation (kyphosis) of the tibia is obvious at birth. It is probably caused by deficient growth of the muscles. It is frequently associated with absence of the fibula and sometimes with other skeletal anomalies. The angulation occurs at the junction of the middle and lower thirds. There is a marked talipes equinus, and the whole limb is short and thin. The skin is puckered at the site of the angulation. The condition may be bilateral. Two cases are presented.

Congenital pseudarthrosis is of unknown cause. It is a purely local condition, apparently due to a deficiency of bone formation. It may be related to, or a form of, osteitis fibrosa cystica. Cases seen before fracture occurs show an anterior bowing of the lower half of the tibia. X-ray examination reveals a zone of osteoporosis or a multilocular cystic area with moderate cortical expansion. After fracture, which is of common occurrence, frank pseudarthrosis may be present or there may be partial attempts at healing. The angulation becomes progressively worse. There is no talipes equinus or dimpling of the skin with congenital pseudarthrosis. The treatment should be non-operative until the age of about seven years. Two cases are presented.

SYDNEY J. HAWLEY, M.D.

Internal Derangements of the Knee Joint in the Canadian Army (Overseas). D. W. MacKenzie and J. A. MacFarlane. Canad. M. A. J. 49: 472-478, December 1943.

This is a review of 303 cases of internal derangement of the knee joint necessitating arthrotomy, followed postoperatively for three to thirty months. The average age was 28 years and the average duration of disability two years. In 90 per cent of the cases there was a history of injury.

Preoperative radiological examination proved to be of importance, since of those patients for whom radiological records were available (82 per cent of the series), 27 per cent revealed some abnormality of the knee joint and the number of patients postoperatively unfit for service in this group was almost five times greater than among those with negative radiographic findings.

The importance of care in diagnosis and surgical conservatism is emphasized. Findings show that small incisions and subtotal meniscectomy usually suffice; operation following first injury is not advised except in cases where a locked knee resists reduction under anesthesia. Important factors in determining the necessity for surgery are age, mechanism of injury, and character and duration of disability. The importance of preoperative instruction in quadriceps exercises is stressed.

MARIE L. CONNELLY, M.D.

Use of Special Views in Roentgenography of the Knee Joint. John D. Camp and Mark B. Coventry. U. S. Nav. M. Bull. 42: 56-58, January 1944.

The authors believe that a complete radiographic examination of the knee joint should include a film of the intercondylar notch. For this view, the patient is placed in the prone position, with the affected knee flexed to an angle of 40° and supported by sandbags. The film is centered $2\frac{1}{2}$ inches below the center of the joint and the tube angled 40° , centering to the film.

In this position the intercondylar notch is projected clear of the patella and tibia.

Moreover, when any disturbance of the patella is suspected, special views of this structure in the vertical and transverse planes should be included. With these additional exposures information not readily apparent on the conventional examination may be obtained.

ELLWOOD W. GODFREY, M.D.

Complete Roentgen and Ophthalmologic Examination for Ochronosis in Two Alcaptonuric Children. Lynn D. Abbott, Jr., Frederick B. Mandeville, and Walter J. Rein. *Virginia M. Monthly* 70: 615-617, December 1943.

The author made complete roentgen examinations and ophthalmologic studies on two colored children aged ten and fifteen years, proved to have alkaptonuria, to determine whether any evidence of ochronosis was present. While the latter condition is usually believed to be due to an accumulation of pigment over a period of years and is generally held to develop in the presence of alkaptonuria only in middle age or later, evidence of the disease has been reported in the eyes as early as the third decade.

According to Pomeranz, Friedman, and Tunick (*Radiology* 37: 295, 1941), the roentgen findings in adults with alkaptonuric ochronosis include changes in the large joints, especially in the dorsal and lumbar articulations, resembling those often found in severe and extensive osteoarthritis of the Marie-Strümpell-Bechterew type, with calcification of the intervertebral disks and cartilages, bridging, and eburnation at weight-bearing surfaces.

The findings in the authors' patients were entirely negative for ochronosis. Epiphyseal development was normal, with normal bone age. The skull vault and sella turcica were normal. Special films of the cartilages of the ears after the technic of Fuchs showed no abnormal areas of cartilage or calcific deposits. Fluoroscopy and films of the chests showed the lungs to be perfectly clear.

Ophthalmologically the eyes showed some alterations due to melanosis but changes attributable to alkaptonuria could not be ascertained. The younger of the two patients, a girl, who excreted the larger amount of homogentisic acid, showed a greater degree of scleral pigmentation than the older, a boy, with a lesser degree of alkaptonuria. J. E. WHITELEATHER, M.D.

OBSTETRICS AND GYNECOLOGY

A Practical Technique for Roentgen Pelvimetry with a New Positioning. A. E. Colcher and Walter Sussman. *Am. J. Roentgenol.* 51: 207-213, February 1944.

A simplified technic for roentgen pelvimetry is described utilizing a new position for an anteroposterior view. The method employs a rotating metal rule marked off in centimeters and held parallel to the table-top by means of an upright standard. For the lateral view the patient is positioned in the usual fashion with the tube centered over the greater trochanter. The ruler is placed at the mid-sacral spine, parallel with the spine and film. For the anteroposterior view the patient is placed flat on the back with the knees semiflexed and separated. This elevates the forepelvis and brings the bituberal, bi-ischial and transverse diameters of the inlet practically on the same level

and in the same plane as the table and the film. The ruler is placed at the level of the tuberosities of the ischium by direct manual palpation or by lowering the ruler 10 cm. below the superior border of the symphysis pubis. This latter measurement was determined by a study of dried pelvis and clinic subjects and was found to be satisfactorily accurate.

It is pointed out that the actual inlet starts from the inner upper margin of the symphysis and extends along the iliopectineal line through the level of the transverse diameter of the inlet and is projected to the sacrum. The anteroposterior diameter of this strait extends from the upper inner margin of the symphysis to a point on the sacrum midway between the brim of the pelvis above and the sciatic notches below. The sum of this diameter and the transverse diameter as measured in the anteroposterior view varies from 22 to 24 cm. in the normal. In a similar manner the anteroposterior and transverse diameters of the mid-pelvis and of the outlet can be measured and added. Those of the mid-pelvis should average between 20 and 22 cm. and those of the outlet between 16 and 18.5 cm. The fetal head when presenting in the mid-line can be measured in both the lateral and anteroposterior views. The method requires only two exposures and the ruler gives direct centimeter measurement on each film without need of correction tables. L. W. PAUL, M.D.

The Subpubic Angle: Radiological Aspects. E. Peter Allen. *Brit. J. Radiol.* 16: 279-282, September 1943.

The importance of a narrow subpubic angle in producing delay in the last stage of labor is well understood, yet its radiological measurement is as yet unsatisfactory. The method of Chassard and Lapiné, in which a special film is made with the patient astride the cassette, stooping forward until the plane through the symphysis pubis and ischial tuberosities is parallel to the film, is subject to one serious error: there is no accurate way to check the position accurately. The method of Caldwell and Moloy, with the patient supine and the beam directed at an angle of 45 degrees toward the symphysis and approximately perpendicular to the descending rami of the pubis, is even less satisfactory, for it is subject to two errors: variations in the angle of the pelvis and inaccurate setting of the central beam. The method of Ince and Young, in which the angle is calculated from anteroposterior and lateral films, does not take into consideration the shape of the subpubic area.

The author advocates using a film made by the Chassard and Lapiné method plus an overlay transparency with a base line 10 cm. long, at the center point of which is erected a measured perpendicular. The base line is placed parallel to the line joining the ischial tuberosities and so that the ends touch the sides of the subpubic arch. The height of the lower edge of the symphysis is read on the perpendicular and is an index of the shape and width of the angle.

SYDNEY J. HAWLEY, M.D.

THE GENITO-URINARY TRACT

Osteo-Nephropathy: A Clinical Consideration of "Renal Rickets." Colter Rule and Arthur Grollman. *Ann. Int. Med.* 20: 63-74, January 1944.

The association of bone changes and renal disease has for some time been designated as "renal rickets."

In view of the plurality of underlying disorders responsible for the clinical syndrome, the authors suggest that the term "osteonephropathy" be substituted, since it indicates the nature of the presenting symptoms without implications as to the pathogenesis. They present the following etiologic classification:

- A. Due to primary urinary tract disturbances
 1. Chronic glomerulonephritis, pyelonephritis, nephrosis
 2. Congenital malformations: Polycystic kidneys, renal hypogenesis
 3. Urinary tract obstruction with secondary renal lesions: Urethral valves; prostatic enlargement; calculi; strictures of urethra, bladder neck or ureter; hydronephrosis
 4. Primary tubular functional changes which may or may not show anatomical changes.
 - (a) Hypochloremic-glycosuric type (deToni-Fanconi syndrome)
 - (b) Hyperchloremic type without glycosuria
- B. Due to primary extra-renal disturbances
 1. Endocrine disease
 - Hyperparathyroidism (osteitis fibrosa cystica)
 2. Metabolic disturbance
 - Cystine storage disease.

The symptoms depend on the fundamental nature of the disorder and on the extent and duration of the renal damage. In most instances, the bones show generalized osteoporosis, deformities (genu valgum or varum, Harrison's groove, rachitic rosary, pigeon breast), and dwarfism. Renal disturbances account for the commonly observed symptoms of nocturia, polyuria and polydipsia, signs of acidosis, and the terminal picture of uremia.

The x-ray film, in some cases, may indicate the fundamental disorder by showing bone cysts, characteristic of primary hyperparathyroidism, calcification in the kidney, or other changes in the genito-urinary tract. In advanced stages there is a greater translucency of the shafts of the long and flat bones and a more porous appearance than in true rickets. Multiple healed fractures may be present.

The blood chemistry and urinary findings are important for the determination of the actual nature of the disease, and these the authors tabulate for the various types.

The great majority of cases of osteonephropathy are due to primary renal disease with well recognized anatomical changes, *i.e.*, groups 1, 2, and 3 under A in the authors' classification. In these cases treatment is directed essentially to the underlying renal disease. Some success is reported with alkali therapy. Vitamin D in daily doses of 20,000 or 30,000 units may result in some healing. Calcium may be given to counteract the tendency of alkali to precipitate tetany. Treatment of the hypochloremic-glycosuric type has been disappointing. In the hyperchloremic type good results were obtained by the authors (in a single case) and by Albright *et al.* (Bull. Johns Hopkins Hosp. 66: 7, 1940) with a low-salt diet, dibasic calcium phosphate daily (6 gm. in divided doses in milk), vitamin D (20,000 units daily), and 30 c.c. of a sodium citrate and citric acid buffer mixture three times a day, half an hour before meals.

Hyperparathyroidism in children is encountered rarely, and the differentiation of osteonephropathy

due to this cause will seldom present difficulty. Parathyroidectomy is followed by good results in cases which are not too far advanced.

Two cases are reported. In the first, secondary to renal tubular dysfunction, the roentgenographic examination of the long bones revealed extensive changes at the proximal and distal ends characteristic of rickets. The diaphyses and metaphyses showed extensive osteoporosis, with marked underdevelopment of all the epiphyseal centers. A flat plate of the abdomen showed shadows of calcareous density arranged in clusters around the kidney pelves and minor calices. Four months later, subsequent to the dietary régime mentioned above, the roentgen examination of the wrists and ankle joints showed marked changes in the appearance of the epiphyses, with considerable calcification and definite evidence of healing of previous rachitic changes. No reduction of renal calcification was evident. Photographs of this patient and roentgenograms showing the bone changes are reproduced.

In the second case, in a 16-month-old girl, roentgen examination of the long bones revealed indistinct outlines of the epiphyses, which were undeveloped and decalcified, with widening of the epiphyseal line, characteristic of active rickets. A flat plate of the abdomen revealed moderate enlargement of the hepatic and splenic shadows. Intravenous and retrograde urography showed bilateral rotation and hydronephrosis, the dilatation being most marked on the right side. The left ureter was dilated and tortuous. The bladder was small and showed a persistent inverted funnel-shaped deformity. The patient was placed on a high potassium diet with added diacalcium phosphate and vitamin D and potassium citrate buffer solution, but the results are not mentioned.

STEPHEN N. TAGER, M.D.

THE VASCULAR SYSTEM

Localized Arterial Thrombosis of Indeterminate Origin. J. R. Learmonth, W. Blackwood, and R. L. Richards. *Edinburgh M. J.* 51: 1-20, January 1944.

Reports of 4 cases of localized arterial thrombosis of undetermined origin in young adults are presented. Vasomotor reactions were studied in all and in 2 a detailed histologic examination of the affected artery was made. The arteriographic findings in 3 of the cases are illustrated. These show a filling defect in the main artery, beginning and ending "squarely." Occasionally active collateral vessels may be seen arising from the thrombosed segment. In general, collaterals are, as is to be expected, dilated and tortuous, especially after sympathectomy.

Arteriography is of particular aid as a guide to treatment. When the length of the blocked segment is extensive, and the thrombus appears to be approaching the mouths of vessels of known anatomical collateral importance, arteriectomy may be undertaken. In such circumstances, all branches arising from the thrombosed segment must be tied close to the parent trunk, in order to preserve the reversal of circulation which occurs at the bifurcation of such branches. On the other hand, inspection of the arteriogram may show that arteriectomy would be difficult if not impossible with preservation of a branch which is contributing substantially to the collateral circulation.

FOREIGN BODIES

A Practical Method for Localization and Removal of Foreign Bodies. W. S. Hotchkiss. Virginia M. Monthly 71: 37-38, January 1944.

In the method described in this paper, the foreign body is visualized on the fluoroscopic screen. The skin area over the site is prepared and a 10-c.c. syringe of 1 per cent novocain with two small caliber needles of adequate length is obtained. Under fluoroscopic visualization one needle is introduced into the skin at a slight angle. Infiltrating novocain ahead, the needle is brought into contact with the foreign body. This can be felt by both the operator and the patient as well as seen on the screen. The syringe is then removed and

the needle left in place. The second needle is applied to the syringe and the same procedure repeated from a different point. Thus, the points of the two needles meet at the actual site of, and in contact with, the foreign body. The patient is then removed to the operating room, and under local anesthesia it is the simplest of tasks to cut down to the juncture point of the needles and remove the foreign body.

This procedure has the advantage of not immobilizing both x-ray equipment and trained personnel for any considerable period of time. Also, it is possible to maintain perfect asepsis. The method requires no special instrument, is simple and accurate, and no extra expenditure of x-ray plates is necessary.

J. E. WHITELEATHER, M.D.

RADIOTHERAPY

NEOPLASMS

Adenolymphoma of the Parotid Salivary Gland. M. Lederman. Brit. J. Radiol. 16: 383-385, December 1943.

Adenolymphoma of the parotid gland is a slow growing tumor, for the most part benign, usually found in males over 40. Only rarely is it bilateral. It seldom produces symptoms, and the diagnosis is based on microscopic examination. The treatment is usually surgical, but the tumor will respond to irradiation in high doses.

Four cases are reported, of which one was malignant. This latter case (Case I) was treated by excision of the tumor, dissection of involved lymph nodes, and telerradium. In spite of the histologic resemblance of the tumor to squamous carcinoma and the presence of inoperable metastases in the cervical lymph nodes, the patient survived ten years from the institution of treatment.

Telerradium therapy was also used in the three benign cases. As to the results, the author says: "That resolution of benign adenolymphomata can be effected by radiotherapy alone is shown by Cases II and IV. In Case II excision of the tumour on the right side was incomplete, and post-operative implantation of radium was obviously effective in eradicating the tumour residue since there was no recurrence up to the time of death six years later. Similarly, there was no recurrence within three years after telerradium treatment to the tumour on the left side. In Case IV, complete disappearance of a recurrent adenolymphoma followed telerradium treatment with no recurrence to date (15 months). In Case III, a fixed, non-encapsulated recurrence was excised and followed by post-operative telerradium, and there was no recurrence for a period of four years. In this instance, however, it is impossible to be certain that any tumour tissue remained after excision, although the clinical and macroscopic features of the recurrent tumour did not suggest that it was of a very localised nature.

"The doses employed in the treatment of the benign tumours are of interest. In Case II, the right tumour received a tumour dose of 4750 r in 91 hours by implantation and the left 5000 r (approximately) in 21 days by telerradium. In Case III, the dose given to the

scar area was 4500 r in 12 days. In Case IV, the tumour dose was 5000 r in 29 days. It would seem, therefore, that benign adenolymphoma can be expected to respond satisfactorily to doses of the order of 5000 r, using either post-operative implantation over a period of 7 days or less, or external radiation over a period of 3-4 weeks." SYDNEY J. HAWLEY, M.D.

Carcinoma of the Parathyroid Gland. Karl A. Meyer and Alex B. Ragins. Surgery 14: 282-295, August 1943.

A case of carcinoma of the parathyroid gland with diffuse fibrocystic disease of the bone is presented, with a detailed postmortem report.

The patient experienced a temporary improvement in the objective and subjective symptoms following extirpation of the tumor twenty-six months before death. After approximately eight months, however, the subjective symptoms reappeared and a year later the fibrocystic skeletal changes became progressively worse despite x-ray irradiation to tumor and bone. There followed a number of pathological fractures with a definite rise in serum phosphorus indicating renal decompensation.

It is of interest that numerous areas of calcification were demonstrated in the soft tissues, particularly the pyramids of the kidney. Calcification was also observed in metastatic lesions of the lymph nodes, in the thyroid, the urinary bladder, and the blood vessels of the heart. There was almost complete destruction of the cortex of the bone. The predominating cell resembled the chief cell, although transitional cells and water-clear cells were occasionally seen.

The effect of radiation in primary hyperplasia of the parathyroid is still a moot question. This patient failed to improve under rather extensive x-ray treatment.

The essential postmortem findings were as follows: recurrent carcinoma of the parathyroid gland with metastases in the peritracheal, subclavicular, and perijugular lymph nodes, the lungs, and the right kidney; generalized osteitis fibrosis cystica; bilateral nephrolithiasis, bilateral chronic ascending pyelonephritis, left pyonephrosis with atrophy of the renal cortex and nephrocalcinosis.

J. E. WHITELEATHER, M.D.

Classification of Laryngeal Cancer from a Radiotherapeutic Viewpoint. M. Lederman. *Brit. J. Radiol.* 16: 298-300, October 1943.

A more informative classification than the usual "intrinsic" and "extrinsic" type of cancer of the larynx is suggested, as follows:

- A. Endolaryngeal
 1. True vocal cord
 2. Ventricle, false cord and infrahyoid epiglottis
 3. Subglottic space
 4. Commissure
 - (a) Anterior
 - (b) Posterior
- B. Laryngopharyngeal
 1. Epilaryngeal
 - (a) Suprahoid epiglottis
 - (b) Aryepiglottic folds
 - (c) Arytoids
 2. Walls of the laryngopharynx
 - (a) Postericoid
 - (b) Pyriform fossae
 - (c) Lateral and posterior walls

This classification fits better the problems presented by the choice of treatment and the prognosis.

SYDNEY J. HAWLEY, M.D.

Cancer of the Larynx: A Radiotherapeutic Test as an Aid in Choosing Between Operation and Irradiation. Max Cutler. *Arch. Otolaryng.* 39: 53-58, January 1944.

In 1941 Cutler described his "concentration technic" of radiotherapy for carcinoma of the mouth, pharynx, and larynx (*J. A. M. A.* 117: 1607, 1941. *Abst. in Radiology* 38: 635, 1942). At that time he found that interrupted treatment—i.e., two cycles with an interval of eleven to fifteen days—was equally as effective as continuous treatment. He now advocates the application of the interrupted technic as a radiotherapeutic test in cancers of the larynx which are too far advanced for laryngofissure but are suitable for either laryngectomy or radiotherapy and in those in which general conditions seem to favor radiotherapy in preference to surgery. Fifteen days after completion of the first roentgen cycle it is possible to judge the response and estimate the relative radiosensitivity of the lesion with reasonable accuracy. If there has been little or no response, the second cycle is omitted, and laryngectomy is performed in four to six weeks. If the response has been favorable, the second cycle of radiotherapy is administered.

This method has been employed in 25 cases of cancer of the larynx and a typical case is reported. A total dose of 3,600 r (measured on the skin) was given in the first cycle. This produced a considerable regression of the tumor and increased mobility of the hemilarynx. Thirty-eight days after the completion of the second cycle, in which 4,000 r were given, there remained only a small, irregular, non-ulcerated nodule about 6 mm. in diameter on the posterior extremity of the right true cord. A third course of roentgen therapy, 2,000 r, was therefore administered, bringing the total dosage for the three cycles to 9,600 r. At the time of this report, approximately fourteen months after the initial roentgen treatment, the patient had gained weight, his voice was normal, and the hemilarynx was normal in appearance and mobility.

The therapeutic test enables one to choose the best

treatment for the particular laryngeal cancer under consideration. Laryngectomy should not be withheld if it offers a greater chance of cure; on the other hand, the patient should be given the advantage of cure by roentgen therapy without laryngectomy if the circumstances warrant.

Technique of Radium Treatment of Intrinsic Cancer of the Larynx. M. Lederman and W. V. Mayncord. *Brit. J. Radiol.* 16: 301-307, October 1943.

Individualization of treatment is nowhere more important than in intrinsic cancer of the larynx. Good results cannot be expected from standardized methods.

Teleradium methods can be successfully individualized. These are particularly suitable for laryngeal cancer, as homogeneity of distribution is not as important here as high localization. The absence of a high depth dose as in x-ray therapy is also an advantage.

Six specimen techniques are worked out in detail for different intralaryngeal situations. Of 15 patients treated five years ago by these methods, 9 are free from disease.

SYDNEY J. HAWLEY, M.D.

X-Ray Treatment of Carcinoma of the Oesophagus. D. Waldron Smithers. *Brit. J. Radiol.* 16: 317-322, October 1943.

This paper describes the application of Mayneord's method of three-dimensional depth dose calculation in esophageal carcinoma. The patients were accurately placed and every effort was used to prevent damage to normal structures. Six fields were treated daily. A tumor dose of 6,000 to 7,000 r was given in five to six weeks.

Forty-four patients were treated, 32 completing the series, and of these 3 are alive and well, one six years and four months, one five years and one month, one four years and nine months after treatment. Symptomatic relief was obtained in 30 patients; 11 became entirely symptom-free for varying periods of time. Fourteen lived for one year or more and 5 for two years or more. Three were found at necropsy to have no sign of residual ulcer or cancer.

SYDNEY J. HAWLEY, M.D.

Carcinoma of the Uterine Cervix: Treatment and Prognosis. Daniel G. Morton. *West. J. Surg.* 52: 1-10, January 1944.

The five-year survival rate of carcinoma of the cervix in patients treated with radium in the University of California Medical School from 1928 to 1931 was 15.2 per cent. This was increased to 35.2 per cent in patients treated from 1931 to 1938 by the additional use of high-voltage roentgen therapy with radical panhysterectomy in selected cases.

Large everted growths are first treated by external irradiation (200 kv. or 1,000 kv.), as much as 4,000 r being delivered to each of four pelvic ports. This is followed in three or more weeks by radium application, the basic dose being 4,500 mg. hr.: 3,000 mg. hr. distributed in the cervico-uterine canal, usually by a tandem of three capsules, and 1,500 mg. hr. in the form of a plaque against the cervix. The total dose is given in three weekly treatments. Roentgen treatment is not without danger and in patients of advanced age or markedly debilitated the dosage is reduced.

Complications of pelvic irradiation include bowel obstruction, visceral bleeding and pain, ureteral stric-

ture, and fracture of the femoral neck. In 18 of 374 patients death was believed to have been precipitated by roentgen therapy. The chief complication of radium treatment is the spread of infection. The use of x-rays first, however, helps to prevent this danger. Fistulas are occurring less frequently and when present are usually due to progression of the growth.

Wertheim panhysterectomy was performed in 100 selected cases of Stage I and II carcinoma (Schmitz) and the author compares the results with those of irradiation in these stages. For 76 cases treated with radiation alone the five-year survival rate was 48.6 per cent; in 56 operated cases 64.2 per cent. The ten-year survival rate was 34.0 per cent of 47 cases treated by irradiation and 58.3 per cent of 48 cases operated upon. Operation should be done only where clinically the new growth is confined to the cervix. The patient should not be older than 55 years and should be in good general condition to survive the shock of surgery; she must not be obese and should have good arm or ankle veins for infusions and transfusions if needed. Although x-ray and radium treatment may make the operation more difficult because of possible fibrosis in the pelvis, this is considered more than offset by the reduction of infection and a lowered incidence of peritonitis. There has been a mortality rate of 2.7 per cent in 78 patients operated upon in the past twenty years.

Urinary fistulas occurred as an operative complication in 13 cases, most of which were either repaired successfully or healed spontaneously. When the parasympathetic fibers to the bladder were partially or completely sectioned, there was loss of sensation of bladder fullness and the patients were unable to control the sudden emptying. Adequate bladder control, however, was re-learned in a few weeks or months at the most.

In prognosis the clinical classification is the most useful factor. The following chances of cure are predicted: Operable Stage I, in young women in good general health suitable for operation: 9 out of 10; Inoperable Stage I, in older women, obese patients, and others in whom operation is unwise: 3 out of 4; Stage II: 1 out of 2; Stage III: 1 out of 4 or 5; Stage IV: 2 or 3 out of 100. LESTER M. J. FREEDMAN, M.D.

Physical Aspects of Intracavitary Radium Treatment of Carcinoma of the Cervix Uteri. Part I. G. J. Neary. *Brit. J. Radiol.* 16: 225-233, August 1943.

The objective in the treatment of cervical carcinoma should be to deliver a dose spatially so distributed that all the malignant cells will be destroyed without producing a dangerous over-reaction in the normal or malignant tissues. Whether or not this can be done depends upon the distribution of the malignant cells.

The present discussion is based upon the following conclusions: (1) The disease is in a large proportion of cases confined to the pelvis. (2) The general trend of spread is laterally. (3) Intracavitary radium plays a fundamental part in the treatment of the disease; the improvement of results by adding supplementary x-ray is disappointingly small.

Anatomical data regarding the lymphatic spread is conflicting. It is apparent, however, that the attention should be directed primarily to the middle node of the medial chain of the external iliac group, 5 to 6 cm. on either side of the cervix.

The objective should be to deliver a certain dose to a

point (A) in the parametrium adjacent to the cervix, to give as great a dose as possible to the principal lymph node (B), and to give a safe dose to the rectovaginal septum opposite the cervix (S).

The uterine applicator alone gives B only about 22.5 per cent of dose at A. The radium near and at the internal os has the greatest effect at A. If it were desirable to improve the ratio between B and A, the radium would have to be removed from the internal os. The ratio of the doses at A and B from vaginal radium depends on the distance. Improvement in the ratio results by increasing the anteroposterior diameter of the vagina at the expense of the lateral, rather than pushing the radium laterally as far as possible.

Combining the two effects, it is found that with fixed and comparable quantities of radium in uterus and vagina, a lateral separation of the vaginal radium sources hardly affects the total dose rates at A and B, while a displacement toward the posterior wall reduces both dose rates almost to the same proportion, so that the combined depth dose ratio of B to A is very little affected by the position of the radium in the vagina, whether it is pushed into the fornices or anywhere else. The specific ratio for the vaginal applicator is usually at least twice that for the uterine applicator, and it is of no value to improve this ratio further while the poor ratio of the uterine applicator has a preponderating effect on the combined ratio of B to A. Thus, apart from altering the distribution of radium in the uterus, the only thing to do is to increase the relative amount of radium in the vagina.

The rectal dose is derived almost entirely from the vaginal radium. If the usual two radium sources in the vagina are combined into one in the mid-line, it will be found that there is little effect on the ratio of the doses at A and B and the dose at S will be reduced, as this permits expanding the anteroposterior diameter at the expense of the lateral.

It is seen, then, that according to the author's formal scheme a single midline source gives a better distribution of radiation.

By calculation of the ratio of radium in the uterus and in the vagina under these circumstances, it is found that when the rectal dose is not markedly less than the dose at A, and when the specific ratio of the uterine applicator is about 0.22, the best dose distribution is obtained when the uterine applicator is left out entirely.

These observations have two clinical applications of significance: (a) the use of a heavy absorber, as gold or platinum, instead of gauze between the vaginal radium and the rectovaginal septum; (b) a drastic modification of the uterine applicator.

A rectal screen of platinum of 1 cm. thickness would suffice to cut the rectal dose to about 30 per cent of its original level so that it would be possible to bring the radium source in the vagina closer to the rectum, and so increase the depth dose ratio of B to A. Or the lateral diameter of the vagina could be increased again and the dose on all the mucosa of the vagina reduced considerably. In fact, the use of an absorbing screen over the rectum should give extraordinary advantages.

Alteration of the uterine applicator so that the radium is concentrated at about 3 cm. above the internal os will give a better ratio of doses at A and B and will permit smaller doses from the vaginal applicator.

These changes require the use of larger amounts of radium than have heretofore been advocated. The use of a platinum absorber will offset the danger to the

rectum. Even with the larger quantities of radium, the total dose is less than with combined radium and x-ray, and a better spatial distribution is obtained.

SYDNEY J. HAWLEY, M.D.

Physical Aspects of Intracavitary Radium Treatment of Carcinoma of the Cervix Uteri. Part II. A Physical Investigation of the Donaldson Technique. G. J. Neary. *Brit. J. Radiol.* 16: 263-269, September 1943.

The Donaldson technic in radium treatment of carcinoma of the cervix uteri is based on the Stockholm method and consists normally of three radium applications of 24 hours each, the first interval being one week and the second two weeks. Two slightly different sets of applicators are used, but in both vaginal applicators the filtration is 0.5 mm. of platinum plus 2 mm. of silver, which is equivalent to 1 mm. of platinum. The uterine tube is about 6 cm. over-all length and 6 mm. in diameter and is slightly bent at the middle to correspond to a moderate ante flexion of the uterus of 15°. In the first type of tube, the National Radium Commission 50 mg. intra-uterine applicator, the filtration is 3 mm. of silver only, which is equivalent to about 0.8 mm. of platinum; there is a single cavity of 4.6 cm. total length. In the second type, the 60 mg. Donaldson tube, there are two separate capsules, 0.5 platinum screen, in an envelope of 2 mm. of silver; the active lengths of the two capsules are each 2 cm. and the distance between them is 8 mm.; the cervical half of the applicator contains 15 mg. and the other half 45 mg. The vaginal applicator is the Donaldson butterfly pessary, consisting of two adjustable boxes on two arms attached to a central stem. The butterfly pessary of the first type has in each box five tubes of 6.25 mg. content, making a total of 62.5 mg. in the vagina; the second type has somewhat smaller boxes and each box contains five tubes of 5 mg. content, making a total of 50 mg. in the vagina. During treatment the boxes lie in the lateral fornices and the distance between them depends on the individual case.

The dose delivered by the Donaldson technic was evaluated in air disregarding tissue absorption. No material change was observed in various positions of the boxes in the fornices. The parametrium receives about 6,750 r. The principal lymph node near the lateral wall of the pelvis receives 1,900 r. Rectal dosages were measured directly with a condenser chamber in the rectum. The anterior wall of the rectum receives 3,000 r. Because of the changes in position it was not practical to determine bladder doses.

There is no evidence that the vaginal vaults receive higher doses with the boxes than with corks, etc. Very little of the mucosa receives more than 14,000 r. The boxes may be regarded as point sources for distances greater than 2 cm.

SYDNEY J. HAWLEY, M.D.

Lymphosarcoma of the Gastro-Intestinal Tract. Report of Twenty Cases. Barton McSwain and John M. Beal. *Ann. Surg.* 119: 108-123, January 1944.

Twenty cases of lymphosarcoma of the gastrointestinal tract, microscopically confirmed, are added to the considerable number previously reported. The largest number of cases occurred in the stomach and large intestine—7 each. The duodenum was the only part of the alimentary tract not represented in the series.

The symptoms are similar to those produced by other lesions of similar location. The most significant finding is a mass appearing soon after the onset of symptoms or a large mass in a patient in good general condition. Because of the similarity of the findings to those of carcinoma, roentgenologic diagnosis is seldom made. The points to be remembered in lymphosarcoma are the large size of the lesion in relation to the duration of symptoms and the presence of whorl-like defects in the barium outline of the stomach. In the colon a double or unusually long mass suggests lymphosarcoma. The gross appearance at operation is suggestive of the diagnosis; the histologic findings are conclusive.

Treatment consists in complete removal of the lesion if possible, with postoperative roentgen therapy if the operator is not certain that the lesion has been entirely eradicated. In the present series cures of five or more years were obtained after roentgen therapy alone in one case, after surgical extirpation in one, and after a combination of the two in one. Nine patients (47 per cent of those followed) were alive and well at the time of the report, without evidence of recurrence from one year to nine and a half years after the diagnosis was established. The mortality for the series was 42 per cent. The average duration of life for the 8 patients who died was 24 months. The average for the entire series was 37 months, but in several instances the diagnosis was only recently made. One patient was alive after seven years and one after nine years. Where metastasis has occurred, the outlook is poor. G. A. CREEL, M.D.

Recurrence of a Teratoma Testis Eleven and a Half Years After Orchidectomy and Irradiation. Percy Zerman. *M.J. Australia* 2: 315-316, Oct. 16, 1943.

This case is reported because of the unusually long interval between operation and recurrence. Metastases were not observed until eleven and one-half years after removal of the primary testicular tumor.

The patient, twenty-four years of age, noticed a swelling of the right testicle. Shortly afterward the testicle was injured in an automobile accident and the swelling increased. Examination showed the enlarged testicle to be the size of a hen's egg; it was smooth, round, and not tender. The left testicle was normal. No masses were felt in the abdomen. A diagnosis of neoplasm was made and a simple orchidectomy was done. Two weeks later a 99-mg. radium pack was applied, centered over the umbilicus, for a dose of 8,500 r at the skin surface. Pathological examination of the operative specimen showed a teratoma, "possibly malignant," but no involvement of the cord or epididymis.

On examination eight years after operation no abdominal or inguinal nodes were palpable. Three years later, however, the patient entered the hospital with several small, stony-hard nodes in the right groin. These proved on section to have a teratomatous structure. Nine radon needles were implanted in a single plane, for an estimated dose of 8,000 r at a point 1.0 cm. below the center of Poupart's ligament. Two months later the nodes had decreased in size, but the patient now had a persistent productive cough. In another month the cough was worse and he was expectorating copious amounts of whitish sputum. A chest film showed nodular fibrosis of the lungs which was thought to be due to an unusual type of metastasis. Death occurred seven weeks later.

Postmortem examination showed a normal left testicle. Metastatic tumor deposits studded the lungs and were confluent at the bases, which were practically solid with tumor tissue. Several lumbar and many para-aortic nodes were involved by new growth. The principal elements of the metastases resembled an adenocarcinoma of the alimentary tract.

Although teratoma is usually considered to be radio-resistant, the inguinal deposits in this case decreased markedly in size following radon therapy and were impalpable shortly before the patient's death. It is probable that the postoperative irradiation may have been sufficient to inactivate the early lymph node metastases and that fibrosis of the regional lymphatics served to delay further spread for many years.

DONALD R. LAING, M.D.

NON-NEOPLASTIC DISEASE

Course of Postoperative Parotitis under Radiation Therapy. Franz Buschke and Simeon T. Cantril. *West J. Surg.* 52: 21-28, January 1944.

Radiation therapy by means of radium or x-rays is followed by regression of postoperative parotitis without suppuration in 65 to 70 per cent of cases and by eventual recovery in spite of suppuration in 15 to 20 per cent. The percentage of deaths in the reported series is fairly constant, being between 10 and 20 per cent.

The usual course is distinct clinical improvement twenty-four to forty-eight hours following irradiation, with sudden cessation of the severe general intoxication, despite increased swelling and edema of the gland during this period. Complete disappearance of the parotitis occurs in eight to fourteen days.

Why a certain number of cases go on to suppuration in spite of treatment is the problem with which the authors are chiefly concerned in this paper, but they are able to come to no definite conclusion on this point. Inadequate drainage, with development of severe edema of Stenson's duct is probably a factor. Suppuration occurs when the disease process breaks through the duct system and invades the glandular tissue. In successful cases, *i.e.*, those in which recovery ensues without suppuration, it would appear that the irradiation has controlled the infection before destruction of the walls of the larger salivary ducts, though no histologic proof of this assumption is available. The nature of the offending organism seems to have no relation to the outcome. The 4 cases in the authors' series that went on to suppuration were treated by sulfonamides along with x-ray therapy, while only one of the 12 patients with an uneventful recovery received chemotherapy. An opinion is expressed that in many of the cases that end fatally, the original condition rather than the parotitis is the cause of death.

LESTER M. J. FREEDMAN, M.D.

Roentgen Irradiation in Polycythemia Vera by Multiple Small Doses to Large Areas of the Body. Laurence L. Robbins. *Am. J. Roentgenol.* 51: 230-235, February 1944.

An analysis is given of 20 cases of polycythemia vera treated at the Massachusetts General Hospital during

the past ten years with small doses of roentgen radiation to large areas of the body. The daily dose consisted of 20 to 50 r and the total doses varied from 200 to 1,200 r per series, the majority of patients receiving 500 to 600 r per series. The field covers the body from knees to neck. This is accomplished by using a 20 X 20 cm. cone and a target-skin distance of 215 cm. The other factors were 200 kv., 0.5 mm. Cu plus 1 mm. Al filter, giving a half-value layer of 0.92 mm. Cu. Weekly white blood counts were done until a normal range was reached; then they were checked daily. A fall in the white blood cells below 4,000 or 5,000 warrants an interruption of treatment.

An analysis of the results obtained in these cases emphasizes two important advantages for this method of treatment. First, it caused no definite ill effects; second, it resulted in longer remissions than had followed other forms of therapy. The method is no more dangerous than others and does not cause roentgen sickness as a rule.

L. W. PAUL, M.D.

DOSAGE

A Simplified Method of Studying Volume Dose Distribution. E. M. Ungar. *Brit. J. Radiol.* 16: 274-278, September 1943.

In irradiating deep lying tumors, the delivery of an adequate dose to the entire mass is a serious problem and each case requires detailed study. The present discussion is confined to circular fields with axially symmetrical dose distributions. The method is a combination of the tinted chart of Holfelder and conventional depth dose charts and Mayneord's contour projector. The depth dose charts are made by cutting out tongues of blue tinted film base and laying them over one another. This gives a shaded chart in steps. These are used to determine the dose distribution not only in the plane of the central ray but in at least two planes above (or below) this and along the sagittal and coronal planes. This will produce a picture in three dimensions of the depth dose distribution.

SYDNEY J. HAWLEY, M.D.

Metabolic Effects of Therapeutic Doses of X and Gamma Radiations. J. S. Mitchell. *Brit. J. Radiol.* 16: 339-343, November 1943.

Experimentally it is shown that therapeutic doses of x and gamma radiation produce significant changes in carbohydrate and nucleic acid metabolism, apparently by means of enzyme inactivation. The dependence of the change in nucleic acid metabolism (as measured by the cytoplasmic absorption of ultraviolet radiation) upon dose and dosage rate is studied in detail. Changes have been detected after 40 r (gamma). The change is practically constant for dosages from 250 to 4,400 r gamma rays and 280 to 1,000 r x-rays. An approximately constant increase in absorption was observed at dosage rates from 1 to 450 r per minute but low values were obtained for dosages under 0.9 r per minute (gamma).

In radiosensitive cases complete recovery occurred in twenty-four hours except in two cases of carcinoma of the vulva where the change persisted for at least thirty days.

SYDNEY J. HAWLEY, M.D.

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A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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RADIOLOGY

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Extravesical Lesions Causing Bladder Neck Obstruction¹

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OBSTRUCTION of the urinary bladder neck is the most common genito-urinary surgical lesion. In spite of this fact, it is the one condition for which patients more often consult the general practitioner or family physician than they do the urologist, the surgeon, or the gynecologist. Early medical literature abounds with articles describing various methods of relieving the distress in such cases, whether it be caused by a calculus, an enlarged prostate, or a new growth. Congenital abnormalities are probably the most common cause of urinary retention in infants and children, while in persons past middle life prostatic enlargement or neoplasms are to be suspected first. The diagnosis of urinary obstruction is accurate and the treatment is specific. Intelligent use and interpretation of cystoscopy, roentgenography, and physiologic chemistry against a background of history and physical findings make this possible.

Disturbances in micturition may be caused by mechanical impediments at the vesical neck. These mechanical impediments may or may not be a part of the genito-urinary system. Practically all of the various conditions causing bladder neck obstruction have been studied extensively, but the most intensive studies have centered about the prostate; other

lesions are of equal importance but are less frequent. Bothe (1) in a discussion of bladder neck obstruction states that the causes may be congenital or acquired and may be classified as follows:

1. Hypertrophied tissue
2. Inflammation
3. Tumors: (a) malignant (b) benign
4. Neuropathic
5. Foreign bodies
6. Congenital valves

Foley (2) declares that one of the most important and in many ways the most difficult problems of urology is that furnished by obstruction to urination at the vesical neck. He further says that a large proportion of such obstructions are caused by benign hypertrophy of the prostate and are easily recognized, but that to think of prostatic hypertrophy as the only cause is to have a distorted view of the problem. He divides the causes of bladder neck obstruction into two classes.

EXTRINSIC

1. Bladder tumors
2. Vesical calculi
3. Foreign bodies

INTRINSIC

1. Disturbances of innervation
 - (a) Central nervous system
 - (b) Peripheral nerve lesions
 - (c) Atony of the bladder
2. Anatomic changes
 - (a) Inflammation
 - (b) Neoplasms
 - (c) Hypertrophy of the trigone

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

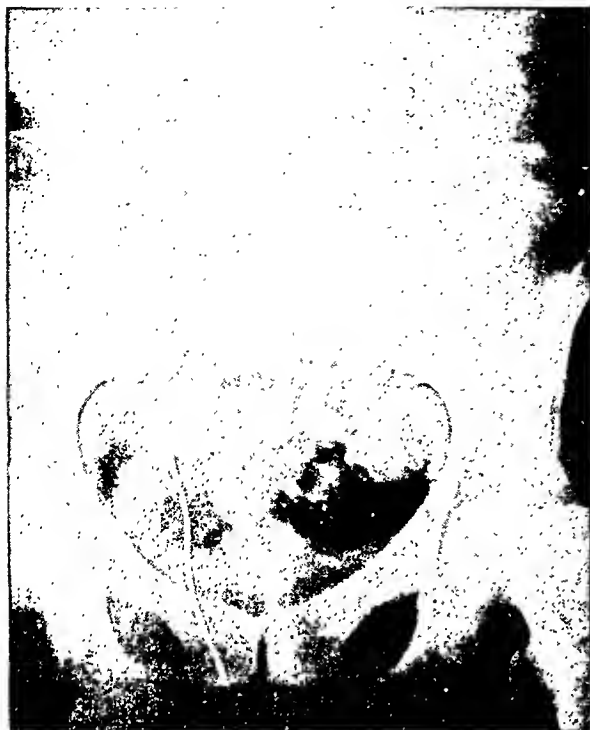


Fig. 1. Case I. Cervical uterine fibroid, with calcification. Film before cystogram, showing displacement of the urethral catheter away from the midline.

Several authors (3, 4, 5) describe unusual obstructions, without prostatic enlargement and other disturbances of micturition, from mechanical impediments at the vesical neck. Lazarus (3) states that obstructive lesions of the urogenital tract are conveniently divided into two groups, supravescical and intravesical, and in his enumeration of the types of lesions he places bladder neoplasms and diverticula obstructing the vesical outlet as next to last in incidence and retroperitoneal tumors as the most infrequent cause of such obstruction.

A review of the literature fails to show any study devoted to bladder neck obstruction from extravescical causes. There is, however, a group of extravescical lesions which, though uncommon, can give all of the historical and physical evidences of bladder obstruction. In fact, the obstruction can be confirmed by the same studies as for prostatic enlargement or any intravesical or urethral lesion causing obstruction. This confirmation, however, may not be necessary inasmuch as a pelvic,

rectal, or roentgen examination will give the true location of the lesion. With recognition of the extravescical nature of the obstruction, its treatment will fall in the field of the general surgeon or of the gynecologist. During the past two years five such cases have come under our observation.

CASE I (Nov. 26, 1941): M. H., female, age 75, gave a history of urinary difficulty for two years, characterized by increased frequency with a sense of obstruction and inability to empty the bladder completely. These symptoms became progressively worse, terminating in complete retention prior to hospitalization. The general health was good. There was no history of vaginal bleeding or of pregnancy.

Examination of the abdomen showed a distended bladder reaching midway to the umbilicus. Catheterization was accomplished with ease. Routine urinalyses were negative. In routine blood studies the hemoglobin was found to be 70 per cent and the red cell count 3,640,000. Pelvic examination was difficult because of a mass largely occluding the vagina from the introitus to the vault. On vaginal and rectal palpation, under intravenous anesthesia the consistency of the mass was that of an adenomatous enlargement of the prostate. A survey film of the abdomen showed calcification, evidently in a fibroid of the uterus. Cystograms, (Fig. 1) showed bladder displacement due to the extravescical mass. Cystoscopy was negative except for urethral pressure deformity.

Diagnosis: Complete bladder neck obstruction due to cervical fibroid.

Treatment: Vaginal enucleation of the tumor.

Result: Complete relief of symptoms.

CASE II (Dec. 14, 1942): G. S., male, age 68, was admitted to the hospital for the fourth time, the previous admissions having been for removal of a sacral chordoma. Following each removal there was a recurrence of the tumor. Entrance at this time was for urinary obstruction and overflow incontinence necessitating catheterization. The patient also complained of a sacral mass, low back pain, and bowel incontinence.

General physical examination showed severe emaciation. There was a large oval mass in the sacral region which encroached upon the rectum. Encroachment on the prostatic urethra was evident by rectal examination. The bladder was distended to the umbilicus. A cystoscope could not be introduced because of obstruction in the prostatic urethra. Cystograms showed a bladder deformity due to an extravescical mass. Cystometric examination was negative. Routine blood studies and urine examination gave normal findings.

Diagnosis: Bladder neck obstruction due to sacral tumor (chordoma) protruding into the pelvis.

Treatment: Permanent cystostomy.

CASE III (March 8, 1943): R. A. S., male, age 54, was confined to the hospital in November 1942 because of a lesion of the left ischium and pubis which roentgenologically showed extensive bone destruction and was subsequently diagnosed pathologically as sarcoma. At the time of the first admission there was incomplete urinary obstruction due to pressure from the extravescical mass occupying the left floor of the pelvis. The obstruction was relieved by a transurethral resection of the prostate, and the tissue removed failed to show any malignant change. The patient was discharged but continued to have pelvic pain and was later confined to his bed because of increasing weakness and edema of the left leg. His urinary difficulties, after leaving the hospital, were characterized by progressive frequency and decrease in size and force of the stream, terminating in complete obstruction before his final admission.

Examination at the time of the second admission showed anemia and emaciation. The bladder was greatly distended, lying as an ovoid mass in the right lower quadrant, with its upper border at the level of the umbilicus. In the left lower quadrant was a hard, fixed mass involving the structures of the inguinal region. A catheter was passed with great difficulty and the displaced bladder was emptied. There was enormous edema of the left leg and genitalia, and lesser edema of the right leg. Rectal examination showed a stony hard mass involving the prostatic area and apparently continuous with the left lower quadrant mass. In the routine blood studies the hemoglobin was 58 per cent, the white cell count 14,600, and the red cell count 2,880,000. An examination of the urine showed evidence of gross infection.

Death occurred on the fourth day of hospitalization. Autopsy revealed an extensive sarcoma involving the left half of the bony pelvis, extending beneath the peritoneum up to the left kidney, and displacing all of the soft tissue structures to the right. Cystograms (Fig. 2) were made post-mortem.

Diagnosis: Sarcoma arising in the left bony pelvis; complete urinary obstruction.

CASE IV (March 17, 1943): C. S., female, age 40, had three attacks of acute urinary retention necessitating catheterization, during the eleven months prior to admission to the hospital. She had been repeatedly catheterized during the present period of obstruction. Her general health was good. There was no history of vaginal bleeding. There had been one pregnancy and no miscarriages.

General physical examination was negative. Abdominal examination revealed a tender distended bladder and after catheterization a mass could be felt above the pelvis. Pelvic examination showed a very large, hard, fixed tumor involving the uterus, which was retroverted and filled the entire cul-de-sac. Urine examination was normal. Routine blood



Fig. 2. Case III. Urethrocytogram, showing sarcoma of left pelvis protruding into the right side and displacing the bladder, with complete obstruction by pressure upon the vesical neck.

studies showed hemoglobin 70 per cent and a red cell count of 3,100,000. Cystograms (Fig. 3) showed bladder deformity.

Diagnosis: Retroverted fibroid uterus.

Treatment: Hysterectomy.

Result: Complete cessation of urinary symptoms.

CASE V (Aug. 5, 1943): R. B., female, age 43, sought treatment because of inability to urinate. She had required catheterization for six months prior to admission to the hospital and during this time she had had several episodes of partial obstruction. There were no other urinary symptoms nor was there any history of vaginal bleeding. The patient's general health was good; she had 5 children; no miscarriages.

General physical examination was negative. Abdominal examination was also negative except for bladder distention midway to the umbilicus. The patient was catheterized with ease. Pelvic examination showed the uterus to be about the size of a grapefruit, uniformly enlarged, and filling the pelvis. Routine urine and blood studies were normal. Cystograms (Fig. 4) showed a definite bladder deformity.

Diagnosis: Prolapsed fibroid uterus with complete urinary bladder neck obstruction.

Treatment: Hysterectomy.

Result: Complete recovery from urinary symptoms.

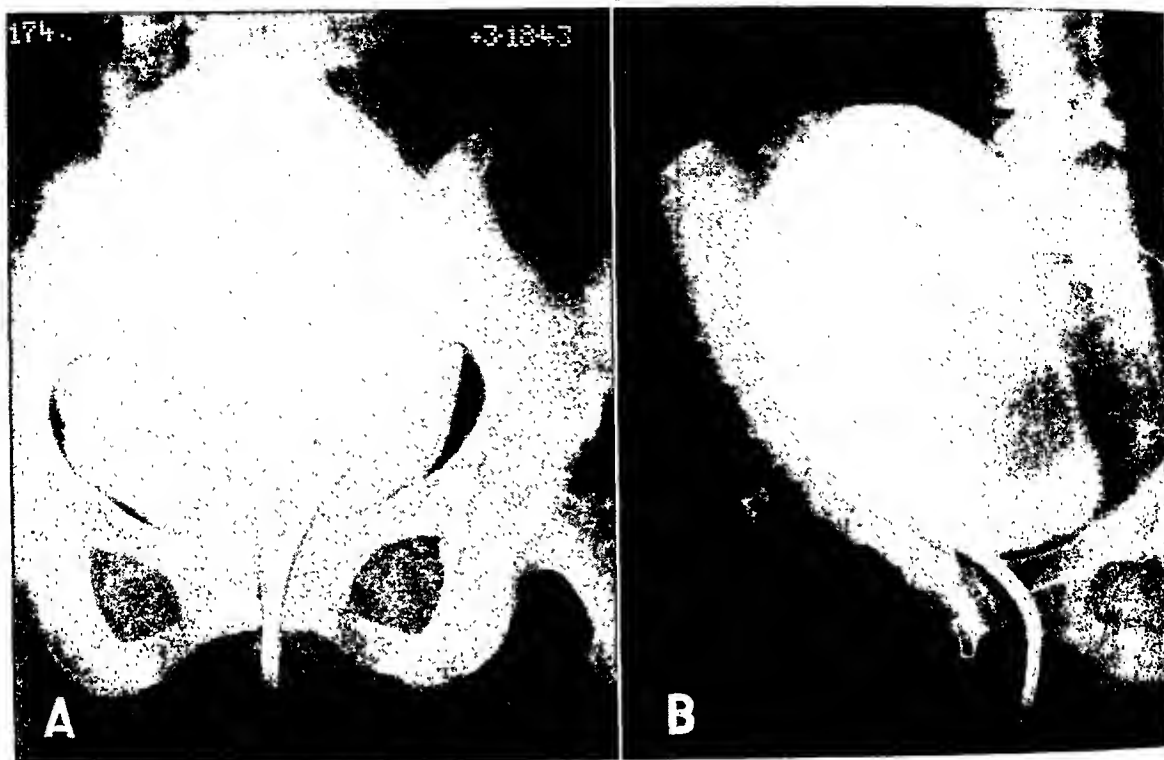


Fig. 3. Case IV. A. Displacement of catheter laterally, distended bladder, pressure defect. B. Defect in posterior aspect of the distended urinary bladder, pressure on vesical neck, anterior displacement of the catheter.

Extravesical lesions causing bladder neck obstruction should offer slight difficulty in diagnosis. They should be suspected if the cystoscopic examination is negative in the presence of a pelvic mass which persists after the bladder has been emptied. The extravesical tumors usually do not cause the rectal symptoms and venous stasis which accompany most retroperitoneal tumors, and for that reason the diagnosis of such lesions may be arrived at by the process of elimination.

In an analysis of the five cases presented it will be found that two general types of lesions enter into consideration. In the females, the lesions were in the uterus, while in the males the lesions were of bony origin.

Two of the females were multiparae and the other a nullipara. Deliveries in each of the child-bearing patients had been difficult and were followed by a marked relaxation of the pelvic floor, which, not being repaired, gave opportunity for prolapse of the heavy uterine tumor, thus blocking the introitus and, by continuity,

the vesical neck. In the non-parous patient the neoplasm originated in the cervix of the uterus and by growth extension, rather than by prolapse, caused mass obstruction at the introitus and pressure obstruction at the vesical neck.

In the two males the lesions had their origin in bone contiguous to the pelvic floor and through tremendous growth pressed aside all soft tissue, finally to constrict and obstruct the fixed vesical neck. Osteomyelitis with soft-tissue abscess has been observed by one of the authors (R. K. R.) to cause bladder distortion and irritation, but never obstruction. Fractures of the bony pelvis cause obstruction by contusion or rupture rather than by pressure.

Lesions of the lower bowel involving the rectum, even though encountered frequently in a far advanced stage, rarely cause vesical neck obstruction. This is probably due to the natural mobility of the gut and to the pelvic fascia, which serves as an effective barrier. Carcinoma of the bowel, being a lesion of an organ



Fig. 4. Case V. Prolapsed uterine fibroid. A. Lateral displacement of urethral catheter. B. Oblique view showing filling defect posteriorly and displacement of the bladder anteriorly.

which is not anatomically fixed, could not then easily cause obstruction of the vesical neck by pressure but only by direct invasion, in which case it could not be termed extravesical.

TREATMENT

Treatment in cases of bladder neck obstruction should be instituted in order to relieve the obstruction and to restore the urinary organs to as near normal function as possible. Early treatment is indicated in order that kidney damage may not become so severe that it cannot be remedied. Blood urea determinations and kidney function tests should be performed in such cases of obstruction, so that the renal function may be known.

SUMMARY AND CONCLUSIONS

1. Five cases of extravesical lesions causing bladder neck obstruction have been presented.
2. A review of the literature has shown that such cases are infrequent or are not reported.

3. Points in differential diagnosis are brought out as related to the more common causes of urinary obstruction.

4. Emphasis is given to the possibility of extra-urinary tract causes of vesical neck obstruction.

5. In all cases of bladder neck obstruction, extravesical causes should be ruled out by appropriate studies. Careful pelvic and rectal examinations together with cystograms are the procedures to be used.

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The Effects of Radiation Therapy in *Clostridium* Infection in Sheep¹

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A LONG DELAYED decision to demonstrate, if possible, the effects of radiation therapy in gas gangrene by animal experimentation finally culminated in such an attempt beginning in March and continuing for nearly four months of 1942.

Sheep were chosen for the experiment at the suggestion of Dr. Sarah Stuart of the National Institute of Health, Washington, D. C., who not only gave this helpful advice but rendered other invaluable aid from time to time throughout the experiment. These animals are quite uniformly susceptible to *Clostridium* infection, they approximate man in size and weight, they are available in this vicinity and are comparatively easily handled, and when purchased out of a flock they have a common sire and an almost identical age.

We began the experiment with the conviction that radiation therapy does have a favorable influence in gas gangrene, both because of personal experience and the much richer clinical experience of others, notably Kelly (1) and Cantril (2). It is entirely reasonable to assume that infections produced by gas-producing organisms are no exception to the general rule, recognized by all radiotherapists worthy of the name, that radiation is a tremendously effective and valuable aid in the treatment of infection (5). Indeed, it would be nothing less than surprising if it could be convincingly shown that radiation therapy, which has long been recognized as a curative agent in the severe and oftentimes otherwise fatal cases of streptococcic infection about the head, face and neck, and of erysipelas, should prove *without* value in gas bacillus infection.

The importance of the size of the animal used in this experiment may be stressed, because in computing radiation doses the surface irradiated is a prime factor, and this is nearly equal in the sheep and the human subject. Dogs are notoriously immune to the pathogenic clostridial infections. This alone introduces an imponderable factor in determining the effects of any treatment (6), to which may be added the wide range in age, size, and blood lines in any kennel. We have found guinea-pigs unsuitable because apparently healthy animals have died when subjected to the amount of radiation recognized as a therapeutic measure in gas bacillus infection, namely, 200 r to 250 r repeated within twenty-four hours. There is no reason to speculate at length on this simple phenomenon when we consider that in exposing the hindquarter of a guinea-pig to radiation we are actually treating at least a third of the body surface and more than a third of the body volume. This, of course, is nothing more nor less than the operation of the inverse square law, which in the case of a small animal means that the radiation effects are distributed without much modification through that part of the body under the selected port. To this incontrovertible fact may be added the effect on sex organs and hollow viscera as well as the blood stream, all of which are relatively close to the target skin distance. These animals are also prone to chew at their wounds, which automatically establishes drainage and this, although crude, nevertheless approximates a treatment of known value in gas gangrene and appreciably vitiates experiments of a strictly non-surgical nature.

A strain of *Cl. welchii* designated as S.R. 12, which was isolated by Dr. Muriel Robertson of the Lister Institute, from a

¹ From the Radiologic Clinic of Drs. Groover, Christie, and Merritt. Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

fatal case of gas gangrene, was employed in this experiment. Twelve sheep were purchased from a flock in the Union Stockyard in Baltimore and were sold to us as yearling lambs having an average weight of 80 lb. Later, 4 others of a different breed were purchased; these were somewhat older, with an average weight of 120 lb. In the first 12 animals the minimal lethal dose of a twenty-four-hour meat-broth culture including spores, non-spores, and toxins was found to be 1 c.c., which amount caused death in an average of 105 hours. The same amount, however, was not definitely established as a minimal lethal dose for the 4 larger animals not of the same breed. Only 3 of these animals were used, however, and of these, one served as a control.

TECHNIC OF INOCULATION

The fleece of the entire right hindquarter of the animal was clipped closely to the skin. At approximately the central portion of the thigh on the lateral aspect, a skin incision 7 cm. in length was made and continued down deeply into the underlying muscle. A muscle bundle was then grasped with a Kelly clamp and thoroughly macerated *in situ*. After pressure control of the slight bleeding, 1 c.c. of the twenty-four-hour broth culture was injected into the macerated muscle and the wound was closed by two silk sutures. There were no material variations in this technic. Control roentgenograms, red and white cell counts, hemoglobin estimation, and rectal temperature were recorded prior to inoculation and at twenty-four-hour intervals thereafter. When the disease was well established as determined by the behavior and appearance of the animals, supplemented by blood findings and gas in the tissues, deep needle punctures were made through a shaved and carbolyzed skin area into the medial aspect of the thigh at least 12 cm. from the point of inoculation. In every instance where there was clinical evidence of the disease, *Cl. welchii* was recovered in pure culture and identified by smears, cultures, and rabbit inocula-

tions. In several animals a 5 per cent glucose in normal saline solution was administered subcutaneously when death seemed imminent, but both treated and control animals received identical treatment in this respect. All dead animals were autopsied and photographed in Kodachrome.

THE DISEASE IN UNTREATED ANIMALS RECEIVING A MINIMAL LETHAL DOSE

A swelling at the site of inoculation appeared in about four hours after the injection, at which time the animal ceased eating and responded sluggishly to ordinary stimuli. No tissue gas could be demonstrated at this period. At the expiration of twelve hours, the swelling had increased in all directions but more apparently as it approached the knee joint. The affected member was favored and in some instances the animal, if standing, bore no weight on it. In general, there were marked acceleration of respiration and profound muscular weakness; animals normally difficult to restrain were limp and listless and could be handled with little or no manifestation of resistance. There was, as a rule, no significant rise in rectal temperature. Body temperatures alone were no index to the severity of the toxemia in any of the animals. At the end of twenty-four hours, the swelling of the affected member had increased and the characteristic odor of gas gangrene was easily detected in the vicinity of the sick animal. Free gas in the affected member could usually be determined by crepitation and x-ray studies at this time. The gas was located either in a considerable pocket at the site of inoculation or was distributed in finger-like projections along the fascial planes. The blood findings were striking and were similar to those reported by Gordon, Stewart, Holman and Taylor (3) in 1940. There was a considerable drop in the hemoglobin, with a pronounced reduction in the red cells, which in some animals amounted to 50 per cent of the normal. A gross clumping of the red blood cells could be easily ob-

served in the chamber of the red cell pipette. There was, as a rule, a temporary decrease in the leukocytes.

Those animals surviving the thirty-hour period were invariably prostrated, refusing food and water and unable to stand, or standing only with difficulty. The involved thigh and leg had increased in size two to three times the normal. The swelling had extended to the flank, across the perineum and along the lateral and ventral aspects of the belly. Bluish or reddish-purple discoloration of the distended skin over the thigh, perineum, and flank was a constant observation, and the gas shadows were easily demonstrable in all the roentgenograms in every animal at that time. The hemolytic anemia became more pronounced and the clumping of the red cells more striking.

AUTOPSY FINDINGS IN ANIMALS DYING OF THE DISEASE

At autopsy the skin was found, on inspection, to be tense over the swollen thigh and leg. The perineum was discolored, presenting a dusky red and dark blue or blue-black appearance. When the skin was incised, a considerable quantity of malodorous serosanguineous fluid escaped. The muscles of the thigh were crepitant and felt distinctly spongy. Crucial incisions deep into the lateral thigh revealed a bubbling, spongy, dark red mass in which the integrity of the muscle was completely lost down to the femur. Muscle bundles, or their remnants, could be easily torn across with the fingers. The appearance of the gas-infected lesion was not unlike red hepatization of the lung in lobar pneumonia. As the skin was dissected or pulled away from the flank and torso, flame-like projections of infection were seen extending to and over the thorax on the affected side. There were no signs of free gas in the thoracic or abdominal cavities, and the viscera appeared normal except for distended loops of gut.

There was one exception to the general picture in an animal surviving twenty-seven and a half hours after inoculation

and dying of an apparently overwhelming toxemia. Clinically there was profound muscular weakness seventeen hours after inoculation, followed by a comatose state until death. This animal received two adequate treatments, one of them an hour and forty-five minutes after inoculation and the second seven hours after inoculation (209 r and 214 r, respectively, to the inoculated thigh and leg). Hematuria was observed at the seventeen-hour period. The right thigh and leg were discolored a bluish red but there was not much swelling. There was no tension of the skin over the involved region.

Grossly in all the animals there was a wide subcutaneous hemorrhagic zone over the inoculated thigh, with extravasation of blood into the right groin. On cut section the muscle was spongy, gaseous, and darkly hemorrhagic, well into the mesial aspect of the thigh. Inspection of the viscera revealed a rather markedly hemorrhagic spleen with the remainder of the abdominal and thoracic viscera grossly negative. The kidneys were grossly normal.

Microscopic studies revealed congestion and edema of the heart, liver, spleen, and kidneys. There was cloudy swelling of the tubules, and the capsules were filled with fine granular and fibrous material. Study of the muscles of the thigh showed fragmentation and vacuolization of the fibers, congestion, and edema, with leukocytic infiltration and several hemorrhagic areas.

The highly objectionable penetrating and putrefactive odor of gas gangrene was present in every autopsied animal dying of the disease.

Death occurred in 3 animals twenty-seven hours after inoculation, and in 2 of these it was nearly simultaneous, being separated by a fifteen-minute interval. One interesting but wholly unrelated phenomenon was the swarm of bluebottle or carrion flies which suddenly appeared, seemingly from nowhere, as soon as the gangrenous areas were opened and as quickly vanished as deep burial of the carcass was completed.

THE DISEASE IN ANIMALS RECEIVING
RADIATION TREATMENT

In general, the toxemia appeared to be modified in the treated animals, in that they were less inclined to lie down and some evinced earlier interest in food and drink, although there was no substantial difference from the controls in respect to body temperature, respiration, or blood find-

permitted to open spontaneously and in 3 animals small stab wounds were made above the knee joint, allowing large quantities (500-1,000 c.c.) of red raspberry-colored fluid to discharge. Ultimate recovery appeared to be uninfluenced by drainage, but there was little or no slough of the skin among the drained cases, whereas a considerable slough oc-

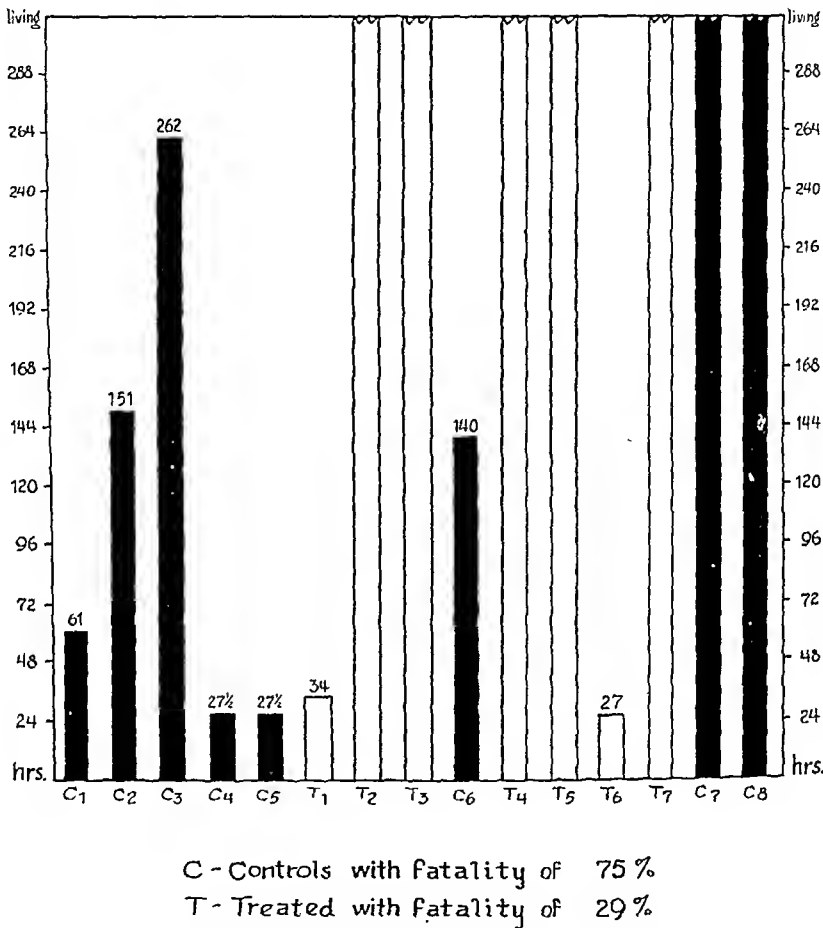


Fig. 1. Results of Clostridium infection in sheep, irradiated and unirradiated.

ings. Actually, as a rule they appeared to be too ill to recover. There was one striking and constant difference between the treated and the untreated animals—in not a single instance among the former was there any evidence of spread of the infection across the perineum or along the flank on the affected side. The infection was confined to the inoculated thigh and leg in every irradiated animal. Several days following treatments, large fluctuating tumors developed. These were at first

curred when drainage was spontaneous. This we attributed to the long-continued distention of the skin and its subsequent necrosis. The slough of the muscle occurred at the point of inoculation, but this was limited to an area 4-5 cm. in diameter and of about the same depth. In the treated animals the *Cl. welchii* infection was arrested and the dominant secondary infection was invariably due to *Staphylococcus albus*, but in no instance was this the cause of death.

X-RAY EQUIPMENT USED AND TREATMENT FACTORS

The regulation U. S. Army mobile field unit was utilized for both radiographic and therapy technic. The apparatus was operated at 100 kv., 4 ma., and 1 mm. aluminum filter added (inherent filtration equivalent to 0.25 mm. aluminum). The focal skin distances were 37 and 55 cm., respectively, depending upon the size of the field indicated. At 37 cm. focal skin distance the size of the field was 30 cm. square; at the 55 cm. focal skin distance the size of the field was such as to include all of the thigh to a point below the knee. The portion of the abdomen included in the field, as well as the underlying opposite leg and distal portion of the thigh, was protected by strips of lead.

The output of the apparatus, measured in air, at 37 cm., was 19.5 r per minute; at 55 cm., it was 9.1 r per minute.

SUMMARY

1. In all of the untreated animals not dying within the first thirty-six hours, the gangrenous process was much more extensive than in the treated animals. This was marked by extension of the gangrene into the deep muscles of the leg to the femur, while in the treated animal the disease in all cases extended no deeper than the superficial muscles.

The disease in the untreated animals was of wider peripheral distribution, extending across the perineum and into the sacral region and across the flank, whereas in the treated animals it was in all cases restricted to the muscles of the inoculated thigh.

2. The immunity of all animals should be determined by blood serum agglutination titration before their use for experimental purposes, and animals showing immunity should be discarded.

3. The minimal lethal dose was not determined for 4 additional sheep of a different breed procured from a different locality and averaging 40 lb. more in weight. All of these factors are important in the response of the animal to the disease. The mortality in the untreated animals was

86 per cent before including the additional animals in the experiment, as compared with 75 per cent after including them. The mortality in those receiving therapy was 25 per cent before including the additional animals as compared with 29 per cent after including them.

As is shown, the addition of the new strain of sheep modified the results to a considerable extent, this strain being more resistant to the disease.

The amount of irradiation therapy given varied from 600 to 1,600 r total dose, but the amount given is no criterion as to the results obtained. Every treated animal was regarded as an individual case and treatment was given according to the severity of the disease and the general condition. Those animals, receiving over 1,000 r received their initial treatment late; they either died, or their disease ran a protracted course with eventual recovery.

It was found that recoveries were better and faster in the animals receiving an early initial treatment of 300 r with a second treatment of at least 200 r within six hours. The subsequent treatments depend entirely upon the course and severity of the disease and there are no absolute criteria for the therapy other than to treat early and adequately.

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Effect of X-Ray Irradiation Upon Bacterial Toxemia in Rabbits¹

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IN A PREVIOUS publication in this journal the writers presented experimental data which showed that in rabbits x-ray irradiation caused the production of non-specific antitoxin. Forty-eight hours after receiving approximately 100 r over the abdomen these animals were able to survive the intraperitoneal administration of a quantity of bacterial toxin which was constantly lethal to the untreated control animals. Two types of toxin were used, a standard diphtheria toxin (supplied by Eli Lilly & Co.) and one produced in our laboratory, a heat-killed culture of a hemolytic *E. coli*. The antitoxin resulting from irradiation was present in both the peritoneal fluid and blood serum. Time was required for its production or elaboration. Although present twenty-four hours following irradiation, it reached maximal concentrations only after forty-eight hours.

These experimental findings suggested certain related problems for investigation. A report of these studies follows.

I. TISSUE SPECIFICITY

Since only the abdomen had been irradiated in the previous experiments, there evolved the question whether this response to irradiation might be peculiar to the peritoneum or certain of the abdominal viscera. It seemed desirable, therefore, to determine the response of the other portions of the body—the chest and extremities—to irradiation.

Twenty-four rabbits were given approximately 100 r each, one half of the animals receiving the rays over the chest and the other half over the extremities. The remaining portions of the body were protected with lead and radiation was administered through one port. It was de-

livered through an inherent filter of 3 mm. aluminum and an added filter of 0.5 mm. copper and 1 mm. aluminum, at 50 cm. target-skin distance, at 140 kv. p. and 15 ma. The intensity of the beam was 20 r per minute, measured in air. The dosage was determined by the duration of exposure and was varied accordingly. Forty-eight hours later one-half of the animals in each group received a minimal lethal dose of diphtheria toxin and the other one-half a minimal lethal dose of the hemolytic *E. coli* toxin. The latter consisted of 4 forty-eight-hour agar slant cultures which had been heat-killed. Six untreated animals were given the same dose of the toxins and acted as controls, 3 for each toxin. All controls died within forty-eight hours. All irradiated animals which received diphtheria toxin survived, as did 9 of the 12 which received the hemolytic *E. coli* toxin. Of the 3 that died, 2 were irradiated over the chest and 1 over the extremities.

From the results of these experiments it may be concluded that antitoxin is produced or elaborated in response to x-ray irradiation irrespective of the portion of the body irradiated. If the sole benefit from irradiation in the treatment of infection is the production of antitoxin, then it is unnecessary to deliver the rays into the infected tissue. Equally good results should follow irradiation of the uninvolved portions of the body.

II. MINIMAL DOSE

It also seemed desirable to determine the minimal dose of radiation required for the production of antitoxin.

Four groups of 8 rabbits each were irradiated over the abdomen, the animals in Group I receiving 50 r; Group II, 30 r; Group III, 20 r; Group IV, 10 r. The factors were the same as those used in the

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

first experiment with the exception of the exposure time. This factor was altered as necessary to obtain the desired gradations of dosage. As in the previous experiment, all animals received intraperitoneal injections of the toxins forty-eight hours after irradiation. Also, 6 unirradiated animals were given the toxins and served as controls. All controls died within sixty hours. Of the 24 rabbits in Groups I, II, and III, 19 survived. Two fatalities each occurred in Groups I and III and one in Group II. In Group IV only one of the 8 animals survived.

These data establish 20 r as being the approximate minimal effective dose for rabbits. Furthermore, this amount of radiation appears to be as productive of antitoxin as the larger doses.

III. IRRADIATED WHOLE BLOOD AND PLASMA

The source of antibodies has never been established. It has been suggested, among other theories, that they are derived from disintegrated leukocytes. It is known, however, that these bodies are contained in the globulin fraction of the plasma. With this theoretical conception and this established fact as a basis for speculation, it was decided to determine the effect of direct irradiation of whole blood and plasma.

Six hundred and twenty cubic centimeters of whole blood were obtained from 20 stock rabbits. One portion of 250 c.c. was defibrinated as it was withdrawn and the remainder, which was citrated, was centrifuged and yielded 180 c.c. of plasma. Both the defibrinated blood and plasma were irradiated with 100 r, the factors being the same as in the first experiment, and then incubated at body temperature for forty-eight hours. One hundred and twenty-five cubic centimeters of serum were recovered from the irradiated defibrinated blood. These collections of plasma and serum were divided into lots of 14 c.c. each, and each lot was mixed with 1 M.L.D. of hemolytic *E. coli* toxin and incubated for four hours. Each lot was then injected into the peritoneal cavity of a

stock rabbit. One of the animals died immediately following the injection, from cause undisclosed by postmortem examination. Of the 12 remaining animals 3 survived. There were also 3 survivors in the group that received the mixture of serum and toxin. The potency of the toxin was checked on 6 control rabbits, all of which died within thirty-six hours.

The problem was restudied with another series of controls. Eighteen rabbits were subjected to a procedure identical to that described above in every detail except that the serum and plasma were not irradiated. Of the 9 animals which received the plasma-toxin mixture 2 survived, and of the 9 which received the serum-toxin 4 survived. All animals which died after receiving the toxin combined with serum or with plasma, whether irradiated or non-irradiated, lived longer than the controls which received only the toxin.

It is apparent that serum and plasma afforded some degree of protection against the toxin used in these experiments. From the fact that the normal non-irradiated was as effective as the irradiated plasma and serum, it may be concluded that irradiation did not increase or in any way alter the factor which is responsible for protection against the toxin and which is present in normal plasma and serum. This raises the question for speculation as to the source of increased protection from the normal plasma and serum which were administered. It is probable that it merely added the antitoxin which it contained to that normally possessed by the animals and that this prolonged life in all and made survival possible in a few instances. Another explanation suggests itself. In the unprotected animals the toxin caused profound shock within four or five hours. The plasma and serum may have contributed only the therapeutic benefit derived from these substances in the treatment of shock.

CONCLUSIONS

1. In rabbits x-ray irradiation causes the production or elaboration of a non-

specific antitoxin. In previous publications, it has been suggested by the writers that this antitoxin is produced by the tissues, probably in response to the insult of the x-rays to the cells.

2. Antitoxin is produced irrespective of the portion of the body irradiated.

3. Twenty roentgens is approximately the minimal dose required to produce an effective quantity of antitoxin in rabbits.

4. Plasma and whole blood do not produce the antitoxin in response to irradiation, nor does irradiation seem to alter the antitoxin that they may normally contain. It would appear that the antitoxin demonstrable in plasma following ir-

radiation is produced in tissues other than blood.

5. These observations made upon rabbits may or may not have counterparts in man. This paper is not concerned with that problem or the controversy regarding the value of x-ray therapy in infection.

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Roentgen Therapy in Gas Bacillus Infection

Report of Nine Cases with Recovery

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KELLY's statements (1) define our position relative to the status of x-ray therapy as an adjunct to surgery in the management of post-traumatic gas bacillus infection. Merritt's description of experimental gas bacillus infection in sheep (2)

in some detail to demonstrate that x-ray therapy can in itself, or in conjunction with surgery, save patients who have an overwhelming gas bacillus infection superimposed upon the shock of severe trauma. The reports also indicate that, while the



Fig. 1. Case I. Compound fracture with deep lacerations, complicated by gas bacillus infection. A. Linear distribution of gas around the elbow joint fracture. B. Photograph taken after débridement. C. Ultimate result.

should answer those (3) who state that "attempts to reproduce clinical effects in animal experiments thus far have failed."

The cases here presented² are described

¹ From the Tumor Institute of the Swedish Hospital, Seattle, Wash. Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

² Cases I to V were included in an earlier report (4). The x-ray therapy in the first two of these cases was managed by Dr. John Wirth, our predecessor at the Tumor Institute.

management of each case is as individual from the x-ray therapy point of view as from the surgical, underlying principles of radiotherapy are utilized in each instance as basically as are the fundamental precepts of surgery in its contribution to the treatment.

We are grateful for the confidence and support of the orthopedic surgeons of our hospital, who consider x-ray therapy an

indispensable agent in the management of gas bacillus infections.

CASE HISTORIES

CASE I: W. H. S., a white male 58 years of age, was admitted to the Swedish Hospital Aug. 31, 1936, twenty-four hours after an automobile accident in which his left arm had been pinned under the car. He sustained a compound fracture of the central portion of the shaft of the left humerus and a deep laceration of the left forearm and distal arm with a dislocation of the left shoulder. Gas bacillus infection was already well established at the time of admission. The wound had been sutured and when it was opened foul smelling gas and discolored blood escaped. Smears of the material showed many organisms resembling *B. welchii*. Subsequent cultures produced gas. The wounds were flushed out by Dr. Roger Anderson and packed with vaseline

mia of the hand, resulting in a demarcated line of gangrene at the elbow. Amputation was done by Dr. Roger Anderson fourteen days after injury. There was no subsequent reinfection of the wound.

CASE III: H. P., a white male 50 years of age, was admitted to the Swedish Hospital Jan. 9, 1941. Five days prior to admission he sustained a compound comminuted fracture of the right tibia and fibula when hit by a rolling log. At that time the wound was treated by débridement and the parts were aligned as well as possible. The patient received sulfanilamide, 90 grains, during the first twenty-four hours after injury, with a change to neoprontosil intramuscularly on the second day because of vomiting. On the third and fourth days, he received sulfathiazole, 60 grains daily. When first seen by us, he was severely toxic. The entire lower extremity was greatly swollen (Fig. 2). There was a laceration at the site of bone extrusion about 2 inches above the ankle, through which gas could

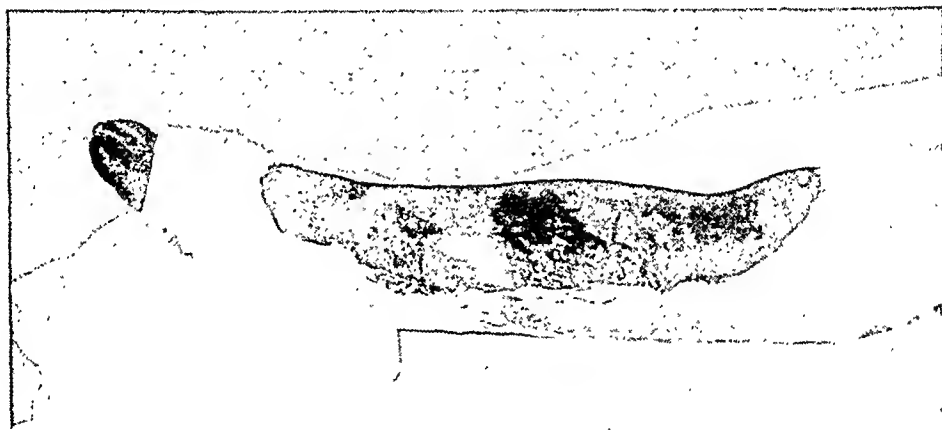


Fig. 2. Case III. Swollen leg with gas bacillus infection, lacerations, and compound fracture.

gauze. The distribution of gas in the soft tissues can be seen in Figure 1. Roentgen therapy was given twice daily for three consecutive days and again on the fifth day. In the first four days the patient received 190,000 units of gas bacillus antitoxin. Recovery ensued without resort to amputation; the present disability is a result of injury to the musculospiral nerve.

CASE II: R. T., a boy 8 years of age, was admitted to the Swedish Hospital May 28, 1937, with a compound fracture of both radius and ulna above the wrist. Roentgen therapy was begun forty hours after the injury, when gas bacillus infection had spread upward, crepitus appearing under the pectoral muscles. There was a partial ischemia of the hand before treatment was begun. After three days of roentgen irradiation, the crepitus and swelling of arm and axilla had disappeared and the general condition of the patient had greatly improved. Gas bacillus antitoxin, 110,000 units, was given during the first four days. There was a progressive ische-

be expressed. A large laceration at the junction of the middle and lower third of the left lower extremity anteriorly was surrounded by an area of gangrenous skin over a distance of about 6 inches. Gas was escaping through this break in the skin. Crepitus extended from the ankle to the lower part of the knee.

Roentgen therapy was begun on the evening of admission to the hospital, five and a half days after injury. The entire lower extremity up to the inguinal region was treated two or three times daily for the first four days. The gas was less widespread on the second day after beginning treatment and on the third day was localized around the wound. Thereafter treatment was given, at first twice daily and then once daily, to the leg only, the total duration of treatment being thirteen days. Crepitus was absent on the eleventh day. Débridement of superficial sloughing skin was done on the eleventh day and on the sixteenth day a more extensive débridement and realignment of the fracture fragments, with in-

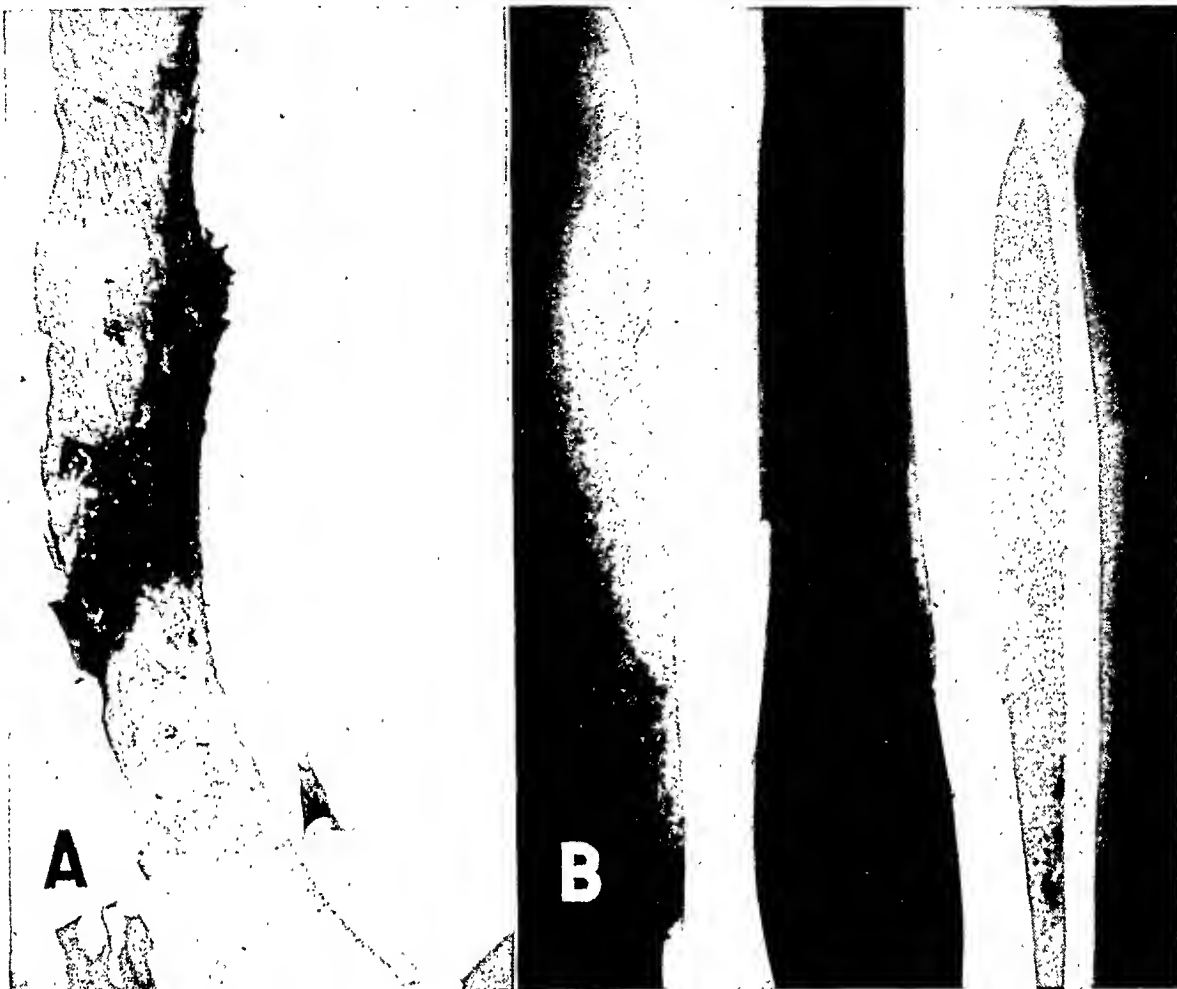


Fig. 3. Case IV. A. Gangrenous leg on admission, nine days after injury. B. Diffuse soft-tissue infiltration by gas.

section of a pin in the os calcis, were done by Dr. John LeCocq. The patient received multiple blood transfusions during the first three days as well as a total of 90,000 units of gas bacillus antitoxin during this period. Chemotherapy was begun after negative cultures for gas bacillus were obtained.

In this patient cultures of pus from the open wound were positive for gas-forming bacilli for forty days after admission, although roentgen therapy was discontinued after the thirteenth day because crepitus was absent, the temperature was 100° to 101° by rectum, and the general condition excellent. Application of chlorazone (2 per cent) packs was begun on the seventeenth day, which greatly improved the secondary infection and cleaned up the denuded surfaces remarkably well. Doctor LeCocq began the instillation of sulfathiazole solution directly into the wound on the day after the appearance of the negative cultures. After the wound had been cleansed and granulations were appearing, he proceeded with the major orthopedic repair—realignment of fragments and fixation by pins and

plaster. In order to promote union of the fragments it was necessary for the patient to wear a walking cast after leaving the hospital. There was no subsequent infection. The only further complication was a late bone sequestrum, which was extruded.

CASE IV: H. M., a white male 24 years of age, was admitted to the Swedish Hospital on Feb. 16, 1941, having sustained a compound comminuted fracture of both bones of the left leg nine days before. The leg had been crushed between cars in a coal mine and was in a cast. At the time of admission the patient was extremely toxic. His temperature was 101° , pulse 112, red blood count 2,200,000, hemoglobin 42 per cent, and white blood count 19,000. When the cast was split by Dr. Roger Anderson, one could see a severe contusion of the lower half of the leg with necrotic skin and muscle bathed in foul-smelling pus (Fig. 3A). There was a sutured incision extending from the knee on the medial side obliquely across the leg to the junction of upper and middle third. From there on the wound was gaping. Crepitus extended from the ankle to just be-



Fig. 4. Case V. Extensive gas bacillus infection of scalp, face, and neck resulting from scalp lacerations: before treatment (left), seven days later (center), and on discharge (right). The scalp wound healed by granulation.

low the knee joint anteriorly, with boggy pockets both laterally and medially in the calf. The foot was moderately cyanotic with reduced peripheral temperature and diminished sensation. Clinically the appearance was that of a gas bacillus infection. During the nine days before admission to the hospital the patient had received sulfanilamide, the exact amount of which we could not determine.

Roentgen therapy was begun on the night of admission and irradiation was given to the entire lower extremity twice daily for the first three days. On the third day the cyanosis and pain in the foot were increased, although the temperature and pulse were coming down. The original smears and cultures from the wound did not show organisms resembling *B. welchii* and no gas was produced in cultures. Subsequent cultures also failed to produce gas; yet the clinical appearance gave every indication of gas infection. The diffuse soft tissue distention by gas is well demonstrated in the roentgenogram (Fig. 3B). Smears and cultures were largely productive of streptococci, and for that reason Doctor Anderson began administration of sulfanilamide orally on the third day, continuing it through sixteen days, with an average daily dose of 45 grains. Roentgen therapy was continued. On the fifth day the temperature was normal, yet one could elicit crepitus throughout the wound. The cyanosis of the foot was daily more noticeable and was accompanied by increasing pain at the ankle.

On the ninth day, because of the gangrene of the foot, Doctor Anderson amputated below the knee. Amputation was done through an area of previous contamination; yet the postoperative course was satisfactory from the point of view of wound infection and the stump remained free from gas infection. Cultures were taken from the deeper portions of the amputated leg and all of these produced abundant amounts of gas in culture. A rabbit

inoculated intraperitoneally and killed after five minutes showed the foamy liver (after twelve hours' incubation) characteristic of gas bacillus infection. Organisms isolated from the animal proved to be *B. welchii*.

We were at a loss to explain the negative smears and cultures in this case during the first seven days under our care. We conjectured that the previous course of sulfanilamide, during nine days before the patient came into the hospital, might possibly have altered the infection, thus accounting for our failure to grow gas-forming organisms. That we did obtain virulent *B. welchii* from the deep pockets of the amputated leg showed us rather that we had not been obtaining our cultures from locations representative of the true bacterial invasion.

A dissection of the amputated leg showed a thrombosis of the posterior tibial artery at the ankle and of the posterior tibial vein deep in the calf.

CASE V: R. T., a white male about 50 years of age, was admitted to the King County Hospital with scalp lacerations and signs of concussion and was discharged with directions to have the dressings changed in the Out-Patient Clinic. He was seen by us in consultation four days after injury, when he was practically moribund. There was a gas bacillus infection involving the entire scalp, face, and neck, with gas exuding from the scalp wound. The eyes and nose were closed by the pressure of entrapped gas. Roentgen irradiation was given through multiple fields to the entire head, neck, and upper thorax on the afternoon on which the patient was first seen. The sutures were then removed from the scalp wound to permit more ready exit of gas. Two ampules of therapeutic gas bacillus antitoxin were also given, which caused a severe subsequent serum reaction.

The patient was treated by Dr. George Bracher and ourselves on seven days over a total period of ten



Fig. 5. Case VI. Multiple fractures of the foot with gas bacillus infection in the soft tissues.

days, radiation being given twice daily for the first three days. Six fields were used to irradiate completely the scalp, face, neck, and upper thorax. A smear and culture of pus from the scalp wound on the day of admission contained *B. welchii* and streptococci. The first smear and culture without gas bacilli appeared on the fifth day after beginning roentgen irradiation. Cultures were thereafter free from gas bacilli but contained streptococci. Sulfanilamide was not begun until the ninth day, that is, four days after gas bacilli could no longer be demonstrated.

Dr. W. E. Watson, the surgical resident, was most co-operative in caring for the wound. It became necessary for him to drain burrowing abscesses under the scalp. A normal temperature was obtained on the sixteenth day, and the patient was discharged on the thirty-first day with a granulating wound.

We feel that this case (Fig. 4) is ample evidence that roentgen irradiation should be given to any patient with gas bacillus infection regardless of the apparently hopeless situation at the outset.

CASE VI: S. R., a white male 57 years of age, was admitted to the Swedish Hospital on April 18, 1941. He had been injured on March 31 by a falling log. A laceration over the outer aspect of the right ankle had been sutured immediately following injury. The patient had been hospitalized elsewhere, and treatment to the injured foot and ankle had been in the form of hot soaks and external heat. While in the hospital he had received a total of 28 grams of sulfathiazole over a period of eight days. Infection in the foot had precluded the application of a cast for existing fractures, and it had

been necessary to drain abscesses by incision through the heel as well as in the region of the inner malleolus.

On admission to the Swedish Hospital (by Dr. Roger Anderson), the entire right foot was greatly swollen, the swelling extending for about 8 cm. above the ankle. There was pitting edema over the dorsum of the foot. Over the posterior aspect of the heel was a deep laceration, with an area of gangrenous skin about 10 cm. in diameter extending from the heel up the lateral margin of the foot above

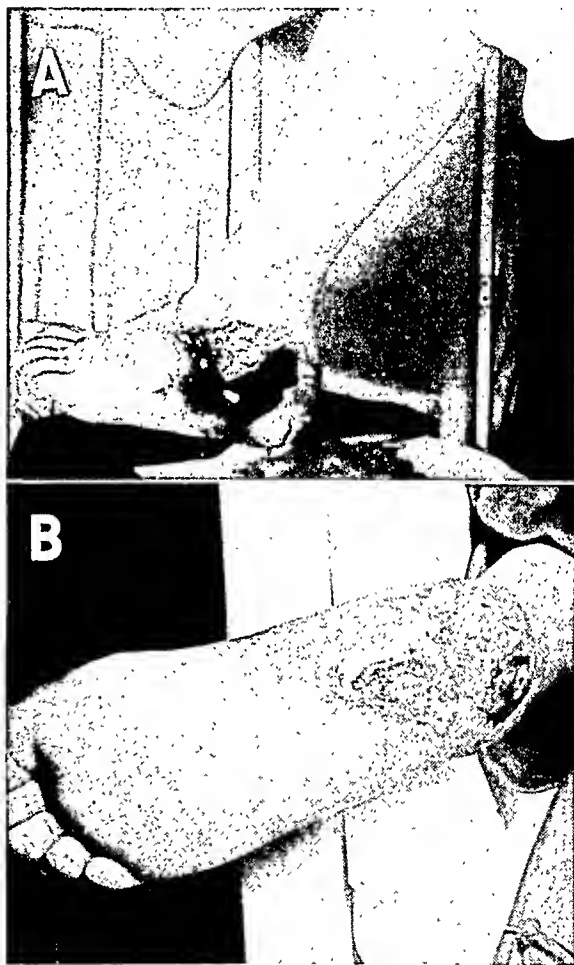


Fig. 6. Case VI. A. Gas bacillus abscess and gangrene with demarcation over the posterior and outer aspect of the foot. B. Condition of foot one year after injury. Reconstructive surgery had been unsuccessful in producing a functional result. Amputation was subsequently done.

the external malleolus. The area of gangrene extended onto the sole and upward to the inner malleolus, where there was a break in the skin through which gas and pus were escaping. Crepitus extended from the heel to the mid-portion of the sole and along both malleoli. There was no crepitus over the dorsum of the foot or above the malleoli. The color of the toes and dorsum of the foot was

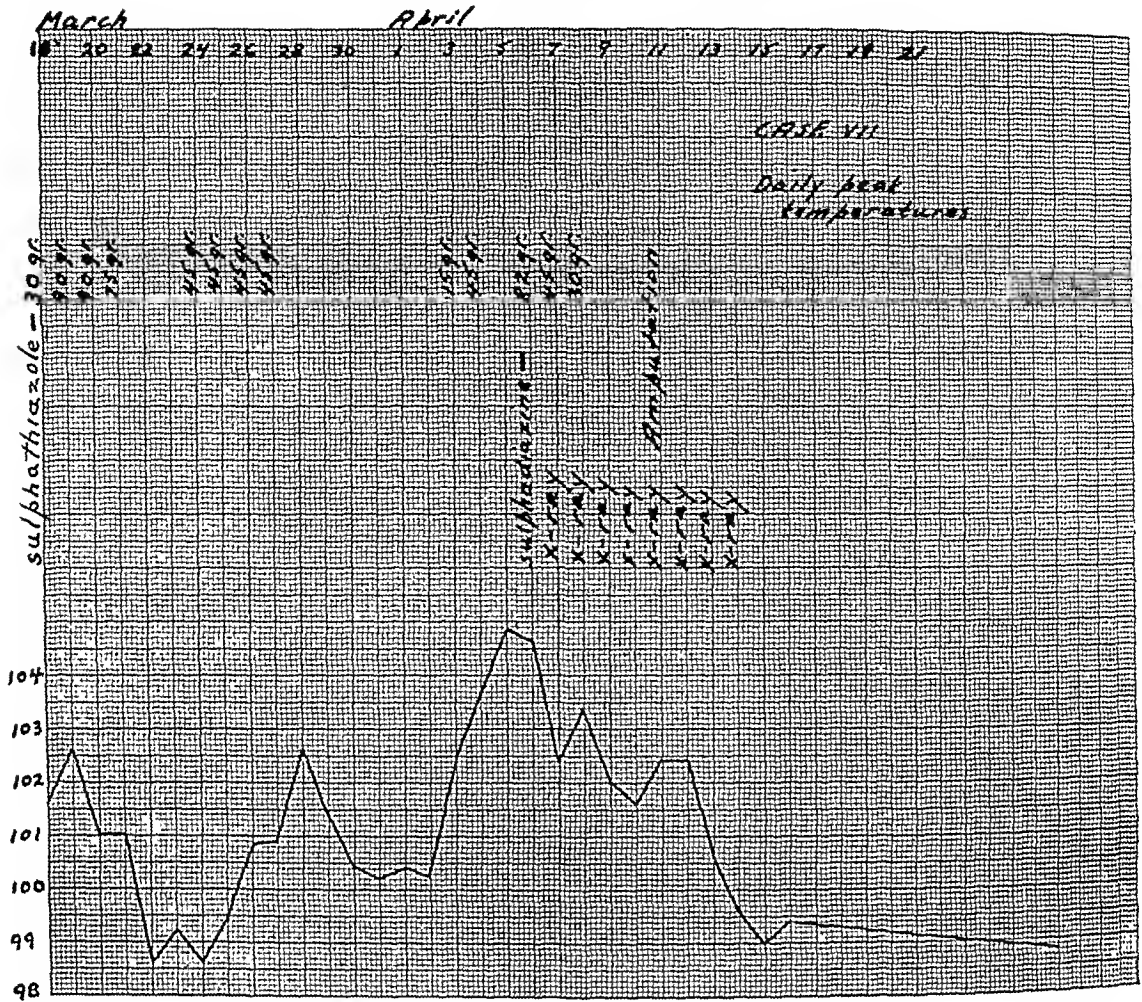


Fig. 7. Case VII. Daily peak temperatures.

good. Sensation was lost over the fifth toe of the right foot. Vessels at the malleolus could not be palpated because of the swelling.

The patient was fairly comfortable. His temperature was not above 100.8°; the pulse was 120; white blood count 19,000 with 86 per cent neutrophils; there was no anemia.

X-ray examination showed a fracture of the os calcis, a transverse fracture of the fifth metatarsal, and a fracture of the fibula just above the ankle. There was a considerable amount of gas in the soft tissues, particularly about the os calcis and ventral surface of the foot (Fig. 5). Cultures of pus exuded from the heel and inner aspect of the ankle produced extensive amounts of gas, and smears demonstrated bacilli of the gas-forming group.

Roentgen therapy was begun immediately and given twice daily for the first seven days and thereafter once daily for five days. The entire leg was treated for the first three days, after which treatment was confined to the ankle and foot. The foot at each treatment was irradiated through medial, lateral, and plantar fields so that it would receive radiation in its entirety. At completion of the treatment,

on the twelfth day, there was still some gas present in the deep fracture of the os calcis but no demonstrable crepitus was elicited elsewhere. The patient was free from pain; temperature and pulse were normal.

At this time Doctor Anderson was not certain that, even though the infection could be brought under control, he would be able to reconstruct a useful foot after the extensive slough of os calcis and soft tissue of the heel which seemed unavoidable. He yielded, however, to our urgency and embarked upon what we felt to be the more conservative plan, an attempt to save the foot and later to reconstruct it. He accordingly waited for demarcation of the gangrenous skin over the heel and outer malleolus and then attempted débridement (Fig. 6A). His initial judgment proved subsequently to have been correct, and had it been followed would have saved the patient eighteen months of time spent in reconstructive surgery.

On May 31, or thirty-two days after the last x-ray treatment, the cultures of pus became negative for gas. At this time the entire os calcis sloughed and there was a huge defect which included the

Achilles tendon and a large part of the soft tissue of the heel, extending down onto the plantar surface. Chlorazene solution soaks were used as a dressing. By June 8 the patient was up on crutches and on July 30 he left the hospital, to return at a later date for plastic reconstruction.

The patient was readmitted Sept. 10 and several times thereafter and an attempt was made to rebuild the foot. This was particularly difficult because of the loss of os calcis and failure of skin grafts to take completely over the region of the heel. The result on April 27, 1942, about one year after injury, is seen in Figure 6B. Amputation was finally done in October 1942, as it was felt that an artificial foot would be more serviceable.

CASE VII: C. S., a white male of 26 years, was admitted to the Swedish Hospital, March 18, 1942. On March 13, a horse which the patient was riding tripped and fell on his left ankle. He managed to remount and ride 20 miles to the nearest doctor. He had sustained fractures of the left tibia and fibula, which were set in a plaster cast, with the insertion of pins to aid alignment. Two days later the foot began to swell.

On admission to the Swedish Hospital (by Dr. Roger Anderson) on March 18, the entire leg, ankle, and foot were edematous and blue. There were blebs over the foot and ankle. The tips of the toes were dry, hard, and black, with loss of sensation. The cast was split and the pins were removed on March 26.

From March 18 to March 28 the patient was given sulfathiazole—an average of 50 grains daily for ten days. Administration was interrupted for six days in favor of sulfadiazine. The daily peak temperatures under chemotherapy are recorded in Figure 7.

We were asked to see the patient on April 7, when it was believed that gas bacilli were present. At that time there was an extensive edema of the leg extending from the knee downwards. There was a dry gangrene of all the toes extending onto the dorsum of the foot and the plantar surface in its entirety. There were numerous blebs over the foot. Gas and pus were exuding from the site of previous transfixion just above the ankle, where there was a sloughing area about 3 cm. in diameter. There was crepitus throughout the entire leg, more pronounced in the mid calf. The dorsalis pedis artery was not palpable. Gas in the tissues could be palpated up to the lower margin of the knee joint. The odor was that of extensive necrosis. The pulse was 120 but of good quality; temperature 102.4°.

The x-ray examination showed a fracture of the left tibia and fibula (Fig. 8), with an extensive gas infiltration of the tissues. The patient was not severely toxic in spite of the high temperature and the accelerated pulse. The white blood count was 19,600 with 60 per cent neutrophils.

The problem at this time was not to save the extremity, but to improve the general condition and



Fig. 8. Case VII. Fracture of tibia and fibula with extensive gas infiltration of soft tissues.

permit amputation under more favorable circumstances. It was agreed that chemotherapy was to be discontinued, but due to a misunderstanding of orders it was continued for three days longer. X-ray therapy was begun on April 7 and given twice in twenty-four hours, for four days, to the entire leg, through six contiguous fields. On April 11 (five days after beginning x-ray therapy) the temperature had dropped to 101.6° and the pulse from 120 to 92. There was, however, an extensive accumulation of pus within the leg which had no adequate drainage, and the gangrene of the part was almost complete. Amputation of the foot just above the ankle was done on April 11, and incision was made over the lateral aspect of the leg to promote drainage of pus. The muscles and tendons of the calf were largely necrotic.

X-ray therapy was given to the stump and up to the lower abdomen on the day of amputation, twice on the following day, and once daily for two days thereafter.

As will be seen from Figure 7, the temperature dropped further following amputation. Drainage

X-ray therapy was given, on the night of admission, to the entire lower extremity through six contiguous portals, extending above Poupart's ligament. The patient also received 500 c.c. of blood and 250 c.c. of plasma, as well as glucose intravenously. Gas bacillus antitoxin (100,000 units) was ordered by Doctor Leavitt to be given intravenously. After 50,000 units had been administered, the patient had a severe serum reaction with a chill which lasted continuously for one and a half hours, despite adrenalin and supportive measures. In his critical condition this was a severe strain on his overburdened body economy.

On the morning after admission the temperature was 98.6° and pulse 98. The general condition was somewhat improved. X-ray therapy was given twice daily for the next three days, the entire extremity from the lower abdominal quadrant downward being irradiated through six portals. During this time the patient received two additional transfusions, glucose intravenously, and more antitoxin (10,000 units). The pulse remained around 100 to 120, but the temperature rose from its first drop to its former level of 102-103°. There was a progressive gangrene of the foot and leg, which by the third day were black. The amount of gas in the tissues was so abundant that when it spontaneously escaped through the wounds it could be heard across the room. The toxemia was such that the patient was partially comatose.

Because of the progressive gangrene from arterial occlusion, amputation was decided upon on the fourth day. The improvement in the strength of the pulse (Fig. 9) gave some hope that the patient could weather the procedure. A mid-thigh guillotine amputation was done. Two transfusions of 500 c.c. each were given on the day of amputation. X-ray therapy was also given twice on this day to the remaining thigh, the region of the hip, and lower abdominal quadrant. Irradiation was continued once daily on the sixth and seventh days. On the eighth day an x-ray examination of the hip (Fig. 10) showed a fracture of the upper femur surrounded by a large amount of gas deep within the thigh. This was drained, and x-ray therapy was continued daily through the tenth day. Although the fever persisted (101-102°), the pulse had greatly improved and remained around 100. The general condition was much better and the patient could take nourishment by mouth. On the thirteenth day the stump was placed in a cast to secure complete immobilization and chemotherapy was begun—90 gr. of sulfadiazine the thirteenth day and 45 gr. for twelve days thereafter. The temperature under this management gradually came down to around 100°. When the cast was removed, on the twenty-fourth day, there were still considerable infection and necrosis in the soft tissues of the stump, but no evidence of gas. Thereafter the temperature remained normal.

A dissection of the amputated extremity showed



Fig. 10. Case VIII. Entrapped gas abscess above level of amputation and around site of fracture.

a complete thrombosis of the femoral artery, beginning about 4 cm. below the level of amputation. A culture from the pus obtained at amputation produced abundant gas under anaerobic conditions.

In all, the patient had received 73,200 units of gas bacillus antitoxin in the first nine days, 4,000 c.c. of blood in the first eight days, 250 c.c. of plasma on the first and sixth days, in addition to glucose intravenously to combat dehydration. X-ray therapy was given over the first ten days: on the night of admission, twice every twenty-four hours for four days thereafter, and once daily on the sixth, eighth, ninth and tenth days. Sulfadiazine was used from the fourteenth to the twenty-sixth day to combat the residual infection after x-ray therapy had been discontinued.

CASE IX: W. J. E., white male 35 years of age, was injured Sept. 22, 1943, at 1 P.M. in the shipyards, having cut himself with a piece of new clean metal over the first interphalangeal joint of the right index finger. He applied a dressing from a first-aid kit which, according to his report, was standing open in the room. Since the bleeding continued, he had a better bandage applied by the nurse. At 4 P.M., he noticed a swelling over the hand and a throbbing pain. He was referred by the attending nurse to a local physician, who recognized the condition as beginning gas infection and sent the patient to Dr. William B. Hutchinson.

The patient was seen about 5:30 P.M. by Doctor

TABLE I: TREATMENT AND RESULTS IN NINE CASES OF GAS GANGRENE

Case	Interval Between Injury and Beginning of X-Ray Therapy	No. of X-Ray Treatments and Total Period of X-Ray Therapy	Maximum No. of Fields and Size	Kilovoltage and Filtration	Dose* per Field per Treatment and Total per Field	Antitoxin	Chemotherapy†	Surgery	Result
I	24 hr.	Twice daily 3 days Once 5th day (Total 5 days)	4 Entire arm	130, 4 mm. Al 200, 0.5 mm. Al + 1.0 mm. Al	50 to 100 r Total 150 to 575 r	190,000 u.	0	Debridement prior to x-ray therapy	Recovery No amputation
II	40 hr.	Three times first day Twice 2d day Once 3d day (Total 3 days)	8 Entire arm and adjacent chest wall	130, 4 mm. Al 200, 0.5 mm. Al + 1.0 mm. Al	50 to 100 r Total 50 to 450 r	110,000 u.	0	Amputation for traumatic gangrene 14 days after injury	Recovery Amputation for traumatic gangrene
III	5 1/2 days	Two or 3 daily 5 days Once daily 8 days (Total 13 days)	7 15 cm. diameter	120, 0.25 mm. Cu + 2.0 mm. Al	50 to 150 r Total 225 to 1275 r	90,000 u.	Sulfanilamide and sulfathiazole prior to entry. Sulfathiazole to wound on 41st day, after gas culture was negative	Debridement and realignment of fracture on 10th day. Positive gas cultures phase still present; toxic phase past	Recovery No amputation
IV	9 days	Twice daily 5 days Once daily 2 days (Total 7 days)	5 15 cm. diameter to 10 X 15 cm.	120, 0.25 mm. Cu + 2.0 mm. Al	50 r Total 50 to 500 r	0	Sulfanilamide begun 9th day, 4 days after gas cultures were negative	Amputation for traumatic gangrene on 9th day. Toxic phase past; gas still present	Recovery Amputation for traumatic gangrene
V	4 days	Twice daily 3 days Once daily 4 days (Total 10 days)	6 15 X 15 cm.	200, 1.0 mm. Cu + 1.0 mm. Al	75 to 150 r Total 150 to 725 r	10,000 u.	Sulfathiazole for 8 days prior to entry, none thereafter	Drainage of abscesses under scalp after gas infection was controlled and cultures were negative	Recovery Amputation of foot 18 months later to obtain functional extremity
VI	19 days	Once on admission Twice daily 6 days Once daily 5 days (Total 12 days)	5 8 X 12 cm. to 15 X 12 cm.	200, 2.0 mm. Cu + 1.0 mm. Al 120, 0.25 mm. Cu + 2.0 mm. Al	75 to 125 r Total 170 to 1500 r	0		Amputation of foot for traumatic gangrene and drainage of gas abscesses of leg, 5 days after beginning x-ray therapy and after the acute toxemia had subsided	Recovery Amputation for traumatic gangrene
VII	6 days	Twice daily 4 days Once day of amputation Twice following day Once daily 2 days (Total 8 days)	8 16 X 12 cm.	200, 2.0 mm. Cu + 1.0 mm. Al	50 to 75 r Total 550 to 825 r	0	Sulfathiazole and sulfadiazine over period of 20 days prior to x-ray therapy and for 2 days after x-ray therapy was begun	Amputation of foot for traumatic gangrene and drainage of gas abscesses of leg, 5 days after beginning x-ray therapy and after the acute toxemia had subsided	Recovery Amputation for traumatic gangrene
VIII	2 days	Once on admission Twice daily 4 days Once on 6th, 8th, 9th, and 10th days (Total 10 days)	10 X 20 cm. to 20 X 20 cm.	200, 2.0 mm. Cu + 1.0 mm. Al 120, 0.25 mm. Cu + 2.0 mm. Al	75 to 115 r Total 150 to 740 r	73,200 u.	Sulfathiazole to wound at time of injury, on 14th day, 9 days after x-ray therapy had been discontinued	Mid-thigh amputation for traumatic gangrene of leg and lower thigh on 4th day. Drainage of gas abscess upper thigh on 8th day	Recovery Amputation for traumatic gangrene
IX	6 1/4 hr.	Three times first day Twice daily 2 days Once daily 2 days (Total 5 days)	6 Entire arm and adjacent chest wall	200, 2.0 mm. Cu + 1.0 mm. Al	100 to 150 r Total 1000 r	0		Wound cleaned up with green soap	Recovery. Patient back to work in 6 days

* Dose measured with back-scatter. Doses are stated in text when known. Days not otherwise stated refer to time after admission to the Swedish Hospital.

Hutchinson. At that time crepitation was noticed reaching somewhat beyond the wrist joint. The wound itself was represented only by a small clean cut about 2 cm. in length. There was no discharge of gas through the wound, which appeared perfectly clean. The hand was cleansed with green soap and water and a new dressing was applied. At 6:30 P.M., the surgeon noticed progression of the crepitation to include the lower third of the forearm. The x-ray picture taken at that time (Fig. 11) showed gas over the dorsum of the metacarpal area.

The patient was seen by us at 7:30 P.M. At that time there was a severe edema, with a throbbing pain over the dorsum of the hand and crepitation extending along the entire forearm up to the elbow joint. The general condition was excellent. Temperature was 98.2°.



Fig. 11. Case IX. Small cut over dorsum of finger. Crepitation over dorsum of hand, visible gas, six hours after injury.

Roentgen therapy was started at 7:45 P.M. The area was divided into six fields from the hand up to the shoulder, the last portal including a portion of the chest wall. Each field received 100 r with 200 kv., 2 mm. copper, 1 mm. aluminum, at 70 cm. distance. Five hours later, at 12:15 A.M., the upper limit of the crepitation had not changed. There was less pain over the dorsum of the hand. At that time a second treatment series was administered, five fields being treated, up to the anterior axillary line but with omission of the chest wall. Again 100 r were applied to each field.

On Sept. 23, at 9:15 A.M., the patient's general condition was still excellent. The throbbing pain in the hand had disappeared. There was less crepitation in the forearm and less swelling over the dorsum of the hand; the crepitation over the hand was about the same as on the previous evening. The same five fields were treated with 100 r each. At 4:30 P.M., there was still some discomfort over the dorsum of hand but pain could be elicited only by palpation. There was still crepitation in this area, but the crepitation over the forearm had regressed considerably and in the upper portion had completely disappeared. At this time the three lower fields, including the hand and forearm up to the elbow, received 150 r each, while the two upper fields, including the upper arm, received 100 r each. The blood count on Sept. 23, 1943, was 13,600 white cells with 64 neutrophils and 32 lymphocytes.

On Sept. 24, the patient again received 150 r to each of the three lower fields in the morning and 100 r to each field in the afternoon. On Sept. 25, 100 r were applied to each of the three lower fields, and on Sept. 26 only the two lower fields, including the hand and about one-third of the forearm, were treated with 100 r each.

During the entire treatment time, the patient was in excellent condition, with good appetite and no clinical sign of intoxication. His temperature remained normal throughout. The crepitation disappeared within the next three days following therapy and the patient left the hospital.

Although we have no bacteriological proof in this case, the clinical diagnosis of a gas bacillus infection was made unanimously by three orthopedic surgeons and the radiologist. A culture could not be ob-

tained because no gas was discharged from the wound, and in order to obtain material for bacteriological investigation it would have been necessary to puncture the normal skin over the dorsum of hand. We hesitated to do this because of the possibility of a secondary infection developing in this area. We believe that this case represents Kelly's pretoxic stage. This is the ideal stage for radiation therapy and the uneventful recovery in this case is probably attributable to the early application of x-rays. No additional treatment of any kind, serum or sulfa drugs, had been given. The infection, in all likelihood, originated in the patient's own skin and should be considered similar to the infection following hypodermic injection, since there was no major injury. This patient probably received more x-ray therapy than was necessary; in all likelihood, the last two treatment periods might have been omitted. He was, however, back at work one week after the injury.

DISCUSSION

An analysis of the foregoing cases brings out certain pertinent questions and conclusions:

1. The group includes all our cases of traumatic gas bacillus infection which have been treated by x-rays. The mortality thus far is zero, but we do not expect that

this record can be maintained. A mortality of 11.2 per cent in 125 cases, as reported by Kelly, still represents a large saving in lives over reports prior to the use of x-ray therapy in this disease.

2. In all the cases with the exception of II and IX, bacteriologic proof was obtained that the infection was due to a gas-producing organism. In 7 instances infection was fulminating, the exceptions being Case VI, which was of the so-called "gas abscess" type with less tendency to rapid spread, and Case IX, which was treated in a very early stage.

3. Two patients with post-traumatic gas bacillus infection of an extremity in which there was no traumatic vascular occlusion accompanied by gangrene (Cases I and III) recovered without amputation. In another similar case (Case VI) amputation was done eighteen months after treatment because it was found impossible to reconstruct a serviceable foot. In 4 cases (II, IV, VII, and VIII) amputation was necessary because of traumatic gangrene of an extremity. In 3 of these cases x-ray therapy unquestionably served to limit the infection, reduce the toxemia, and permit amputation at a time when it could be withstood with greater likelihood of survival. In Case VIII, which was the most critical of this group, we believe that, although the x-ray did contribute something to the general condition of the patient and help to lessen the toxemia, the extent of traumatic gangrene was such that further postponement of amputation would have been fatal. A subsequent gas abscess above the line of amputation necessitated further drainage. Spread beyond this point was, however, controlled.

One patient (Case V), with severe infection involving the scalp and face, made a rapid recovery in five days. Surgery after that date served to drain abscesses due to secondary invading bacteria which had accumulated under the scalp.

4. Four patients (Cases I, II, III, and VIII) received gas bacillus antitoxin in therapeutic amounts. One (Case V) received only 10,000 units, which was suffi-

cient only to cause a severe serum reaction. Three cases (Cases IV, VI, VII) received no antitoxin. Kelly has reported a group of 46 cases treated with x-ray and no serum, with a mortality of 4.3 per cent, and concludes that the low mortality when both are employed is due to the radiation and not to the use of serum. We agree with this point of view and have not urged our surgical colleagues with whom we have collaborated to use antitoxin. It is our belief that the patients who received antitoxin would have recovered as well without it. Kelly's reports and our own 3 cases in which no antitoxin was given lead us to this conclusion. Our critics (3) hold that, "in view of the generally accepted efficacy of serum in the treatment of gas bacillus infection, it would be difficult to say whether the recovery of four patients was due to roentgen therapy or to serum therapy." The answer would appear to be found in the mortality figures given by Kelly (1): 35 to 50 per cent when serum therapy is combined with surgery, 4.3 per cent with x-ray therapy and surgery without serum.

5. Three patients received no chemotherapy, two of them probably because they were treated before the sulfonamides came into use. Two patients (Cases IV and VI) received sulfonamides for nine days prior to admission; one (Case VII) received interrupted doses averaging about 35 grains daily for twenty days before we saw him. In one (Case VIII) sulfathiazole was applied directly to the wound at the time of injury.

In two patients (Cases III and V) chemotherapy was used effectively for the secondary infection after the gas bacillus infection had been controlled and x-ray therapy had been discontinued. In one case (IV) sporadic chemotherapy was begun three days after x-ray therapy was started and continued through sixteen days. In one case (VIII) chemotherapy was used after amputation and subsidence of the acute toxic phase of the infection; a smoldering gas infection was present when it was begun but no gas was present twelve days

later, when the stump was examined following the removal of a cast, which had been applied to secure immobilization to control the residual infection.

In none of these cases is there evidence that chemotherapy had a place in controlling the progression of the gas bacillus infection. When used to combat the secondary bacterial invasion after the spread of gas infection had been brought under control, it seems to have produced good results in Cases III, V, and VIII.

6. Certain of these cases demonstrate the ability of the patient to deal with gas bacillus infection if he can be helped over the initial acute toxic phase. This is well demonstrated in Case III, in which x-ray therapy was discontinued on the thirteenth day, when crepitus was absent, though the culture still produced gas. The general condition of the patient by this time was greatly improved, though negative cultures for gas were not obtained until the fortieth day. In Case VI x-ray therapy was discontinued on the twelfth day, but it was not until thirty-two days later that cul-

tures became negative for gas-producing organisms.

The civilian surgeon, faced with a single case of traumatic gas bacillus infection, or the military surgeon with a ward full of its victims, is confronted by a menace to the life and future welfare of his patients. Well directed roentgen therapy has proved its efficacy in saving both lives and limbs. The thoughtful and diligent combination of surgery and x-ray therapy can produce results not heretofore obtained by any approach to this most severe complication of traumatic wounds.

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Clinical and Roentgenological Study of the Effects of Hormonal Therapy on Bone Growth¹

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THE EFFECT OF hormonal therapy on growth in children has been under investigation in the Endocrine Clinic of the Beth Israel Hospital for the past eight years. Growth rate observations were made not only on children treated for growth deficiency, but also on those showing hypogenitalism, cryptorchidism, pseudo-Frölich's syndrome, obesity, and mental retardation.

Clinical observations of growth and of genital and somatic development were conducted. Prior to, during, and after therapy, routine roentgen studies of the skull, sella turcica, and long bones were made at regular intervals. The skeletal age was estimated by the epiphyseal development of the distal ends of the radius, ulna, metacarpals, and the phalanges of the hands, by the presence of the centers of ossification, and the number of carpal bones. The progress of skeletal development was judged in accordance with the standards of Todd (18). The degree of mineralization was estimated by those standards established for the study of osseous structure.

These studies were carried out on a group of 81 children, of whom 65 were clinic patients and 16 were private patients. The therapeutic agents employed were: thyroid substance² in 18 children, anterior pituitary extracts (growth hormones)³ in 26 children, chorionic gonadotropin (extract of human pregnancy urine)⁴ in 19 children, and male sex hormone (testo-

sterone preparations)⁵ in 18 children (Table I). Our clinical observations of this and other groups of children have been reported in previous communications (4). This presentation is concerned with the effect of the various hormones on skeletal growth, bone density, and epiphyseal union.

A considerable amount of experimental work in this field, on mice, rats, and guinea-pigs, has been carried out by well known investigators (3, 6-10, 13-17). While there is no complete accord on the subject, the majority of investigators agree that thyroid substance and anterior pituitary growth hormones stimulate skeletal growth and maturation. If treatment is carried out over prolonged periods of time, accelerated bone aging and cessation of growth may occur. These findings apply, also, to the testosterone preparations and in a lesser degree to chorionic gonadotropin. Experimental observations in animals, however, and clinical results in man do not always coincide. The size of laboratory animals, their brief span of life, the dosage of the hormones used, and the duration of the therapy are generally out of proportion to the therapeutic doses administered to children over comparatively short periods.

THYROID THERAPY

True cretinism and hypothyroidism are frequently characterized by the delayed appearance of ossification centers, subnormal bone density, chondro-epiphysitis, striations of the diaphysis, and other evidences of metabolic disturbances and deficiencies. In many patients, x-ray examination fails to confirm the presence of hypothyroidism. The diagnosis, however, may depend on other laboratory and clinical

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² Desiccated thyroid substance, U.S.P.

³ The anterior pituitary growth extracts used were as follows: Growth Complex (Ayerst, McKenna & Harrison); Phyone (Wilson Lab.); Antuitrin G (Parke, Davis & Co.).

⁴ The chorionic gonadotropin (A.P.L.) used in our series of cases was supplied through the courtesy of Ayerst, McKenna & Harrison.

⁵ The testosterone preparations (Oreton, Oreton M., and testosterone pellets) were supplied through the courtesy of Dr. Max Gilbert of the Schering Corporation of Bloomfield, N. J.

TABLE I: EFFECTS OF HORMONE THERAPY ON GROWTH RATE

Therapy	No. Cases	Ages in Years	Average Dosage	Duration of Therapy	Growth Rate
Thyroid substance	18	4 to 16	1/4 to 3 gr. daily	4 mo. to 7 yr.	Increased in 8 cases Maintained in 10 cases
Anterior pituitary growth extract	26	6 to 17	1 to 2 c.c. 2 to 3 times per week	2 to 24 mo.	Increased in 8 cases Maintained in 18 cases
Chorionic gonadotropin	19	3 1/2 to 17	500 I.U. 2 to 3 times per week	2 to 24 mo.	Increased in 17 cases Maintained in 2 cases
Testosterone compounds Orally Parenterally Implantation	18	8 to 18	10 mg. twice daily 10 to 25 mg. twice weekly 300 to 500-mg. pellets every 6 months	2 mo. to 4 yr.	Increased in 16 cases Maintained in 2 cases

TABLE II: EFFECT OF HORMONAL THERAPY ON SKELETAL GROWTH AND STRUCTURAL DENSITY

	Thyroid Substance 18 Cases		Growth Hormone 26 Cases		Chorionic Gonadotropin 19 Cases		Testosterone Preparations 18 Cases	
	Before Therapy	After Therapy	Before Therapy	After Therapy	Before Therapy	After Therapy	Before Therapy	After Therapy
Normal epiphyseal union and skeletal structural density	8	13	7	11	14	15	7	8
Delayed epiphyseal union	6	5	14	11	4	2	9	8
Accelerated epiphyseal union	0	0	3	4	0	0	0	0
Decreased structural density (degree of rarefaction)	4	0	2	0	1	0	2	0
Excessive structural density (degree of radiopacity)	0	0	0	0	0	2	0	2

ical evidence, such as a low basal metabolic rate, elevated blood cholesterol, pallid dry skin, coarse hair, pudgy hands and feet, and mental sluggishness and retardation.

The group of patients studied by us consisted of 18 children who presented clinical and laboratory features of hypothyroidism. The x-ray evidences, when present, were deficient bone density and maturation. Normal epiphyseal union and skeletal structural density were present in 8 children; in 6 there was delayed epiphyseal union, and in 3 of these decreased bone density was also observed; decreased structural density without delay in epiphyseal union was present in 4 children. Following therapy with thyroid substance, there was an improvement in bone density in all cases, but the delay in epiphyseal union was still present in 5 out of 6 subjects (Table II).

CASE I: V. L., white female, age 7, height 40 in., weight 44 lb., was admitted to the Endocrine Clinic because of mental retardation and clinical symptoms of hypothyroidism, including stunted growth, pudgy hands and extremities, and coarse hair.

The blood Wassermann reaction was negative. Blood chemistry studies showed, for 100 c.c. of blood: calcium, 14.6 mg.; phosphorus, 5.2 mg.; cholesterol, 200 to 333.2 mg. The basal metabolic rate ranged between -30 and -17. Roentgen examination of the long bones revealed a delay in the appearance of the centers of ossification; the ulnar epiphyses were absent, there was a delay in epiphyseal union, and only 4 metacarpal bones were present. There was also a decrease in bone density and scorings were present on the radius. The estimated skeletal age was approximately 3 years 3 months, a delay of about three and a half years (Fig. 1).

Thyroid therapy was carried out at irregular intervals for three and a half years. The dosage administered varied from 1/4 to 1/2 gr. of thyroid substance twice daily. Throughout this period roentgen studies of the long bones were made at intervals and gradual improvement in osseous structural density was observed.

Roentgen studies at the end of the three-and-a-half-year period showed the centers of ossification to be normal; the epiphyseal development was slightly advanced, mineralization was moderate, and the scorings on the radius were present. The skeletal age was approximately 11 years 3 months, whereas the actual age was 10 1/2 years (Fig. 2). Clinically the progress of growth was satisfactory. During the period of treatment, the child grew 9 1/2 in. Although the physical development progressed satisfactorily, the mental retardation was not noticeably affected.

GROWTH HORMONE THERAPY

Twenty-six children whose growth was stunted were treated with anterior pituitary growth extracts. Before therapy was begun, the majority of these children showed retarded bone development for their age period. Delayed epiphyseal union, delayed appearance of the centers of ossification, and subnormal bone density were revealed by x-ray. In 3 children a premature advance in the size and density of the bones was observed, but the epiphyseal lines remained open.

During the course of therapy and subsequently, skeletal growth and development proceeded normally in 11 children. In another group of 11 children the initial delay in epiphyseal union persisted after the completion of therapy. In the 4 remaining members of this group there was evidence of rapid bone maturation and epiphyseal closure. In 3 of these children, as mentioned, a premature advance in the size and density of the bones was observed before therapy was instituted (Table II).

Anterior pituitary growth extract⁶ was administered in doses of 1 to 2 c.c. two to three times a week for periods ranging from

⁶ When our work with growth hormones began some eight years ago, the only preparations available were the crude extracts which were unstandardized, and it is therefore difficult to evaluate their exact strength. For approximately five years, however, we have employed the standardized material of Ayerst, McKenna, and Harrison, each cubic centimeter of which was stated to contain 10 R.U. (Collip units). In the last three years the units per cubic centimeter were raised to 100 R.U. (Collip units). While during this development there were apparent increases in the strength of the material used, the effect on bone growth and maturation did not seem to be materially different with the variations in concentration. Twenty-one patients were treated with Growth Complex (Ayerst), 3 with Phyone (Wilson), and 2 with Antuitrin "G" (Parke, Davis).

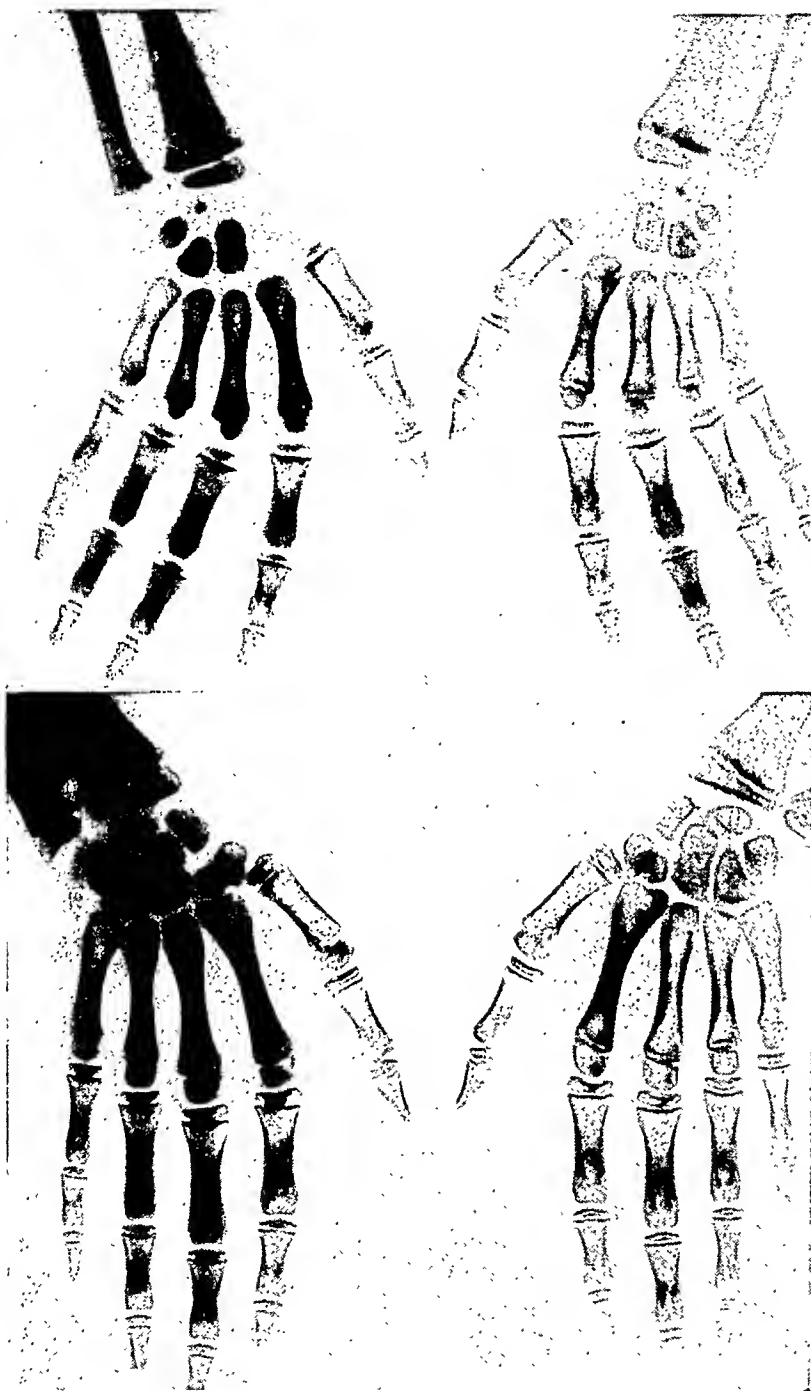
two months to two years, with intervals of rest periods in the protracted cases, which varied from four to six weeks every three or four months. No appreciable difference was noted in the various commercial preparations employed.

Eight of this group of 26 children showed an acceleration in bone growth rate. In the remaining 18 children anterior pituitary growth extract therapy was ineffectual. Of the 8 patients responding favorably, 5, whose ages ranged from 10 1/2 to 14 years, showed a moderate response. Three children in the age range of 15 1/2 to 17 years showed a good response. A growth spurt may occur in adolescents, however, without the employment of any therapy.

Our findings are in comparative harmony with those of Silberberg and Silberberg (16), who carried out extensive experiments for several years on mice and guinea-pigs. These animals were injected with 1 c.c. of anterior pituitary growth hormone⁷ extracts daily for periods ranging from four days to six months. The initial effect was a stimulation of growth of the cartilage at the epiphyseal line. With further injections the epiphyseal lines became narrow and calcified and premature bone aging became apparent. A certain percentage of treated animals did not show this tendency to accelerated calcification.

If any response at all to the growth extract therapy was achieved in our children, it seemed to be only a temporary stimulation of the growth of epiphyseal cartilage. This may have been due to various factors: (1) The amount of anterior pituitary growth extract administered in proportion to body weight was much smaller than that administered to guinea-pigs. (2) The guinea-pigs received treatment at more frequent intervals—i.e., daily—than the patients. Therefore, the amount, duration, and intensity of therapy which our patients received may have been insufficient to produce any marked skeletal changes. The response to hormonal medication may vary in individuals, as it does in animals.

⁷ Antuitrin "G" (Parke, Davis) was employed.



Figs. 1 and 2. Case I: Results of thyroid therapy.

Fig. 1 (above). Age 7 years. Height 40 in. Weight 44 lb. Skeletal age 3 years 3 months. Delayed appearance of centers of ossification; absence of ulnar epiphyses; delayed epiphyseal development. Only 4 metacarpal bones. Mineralization light. Scorings present on radius.

Fig. 2 (below). Age 10 1/2 years. Height 57 1/2 in. Weight 106 lb. Skeletal age 11 years 3 months. Normal centers of ossification. Epiphyseal development slightly advanced. Mineralization moderate. Scorings present on radius.

The favorable response in the few cases mentioned may have been due to the influence of the anterior pituitary growth extract or to the tendency to a sudden acceleration of growth at adolescence.

CASE II: H. F., white male, age 17, was admitted to the Endocrine Clinic for growth retardation on Aug. 22, 1940. On admission his height was 60 1/2 in., weight 82 lb. His physical development was childish and he was shy and reticent. Roentgen examination of the hands and wrists showed a slight degree of mineralization as evidenced by subnormal structural density and apparent narrowing of the cortices of the phalanges and a delay in epiphyseal union. Estimation of the delay in epiphyseal union was based on the open epiphyses of the metacarpals and phalanges. The approximate skeletal age was 14 years 9 months (Fig. 3).

Anterior pituitary growth extract⁸ was administered over a period of eight months, a total of 220 c.c. being given during this time. At the completion of therapy there was an increase of 1 1/2 in. in height. Growth continued and at the end of a year the total increase in height was 4 in., as compared to 3/4 in., during the year preceding therapy. The voice deepened, genital development was accelerated and there was increased assurance.

Roentgen studies carried out a year and a half after the initiation of therapy showed an elongation of the vertical axis of the metacarpals and phalanges; retardation of epiphyseal union still persisted; there was no increase in bone density (Fig. 4). The skeletal age was slightly advanced, to 15 years 3 months.

This case illustrates a favorable response to anterior pituitary growth extract. The coincidence of treatment and adolescence must, however, be considered.

CHORIONIC GONADOTROPIN THERAPY

In our earlier publication (1942) we reported growth observations on 50 children treated with chorionic gonadotropin (4). Sixty-two per cent of these showed an increase in growth rate and 38 per cent maintained their original growth rate. There was an increase in the genital development in all of the children thus treated. Detailed roentgen studies were carried out on 19 children in this group. X-ray studies of the long bones were made with special reference to bone density, size, and degree of maturation, and particularly epiphyseal union, whether it was retarded, normal, or

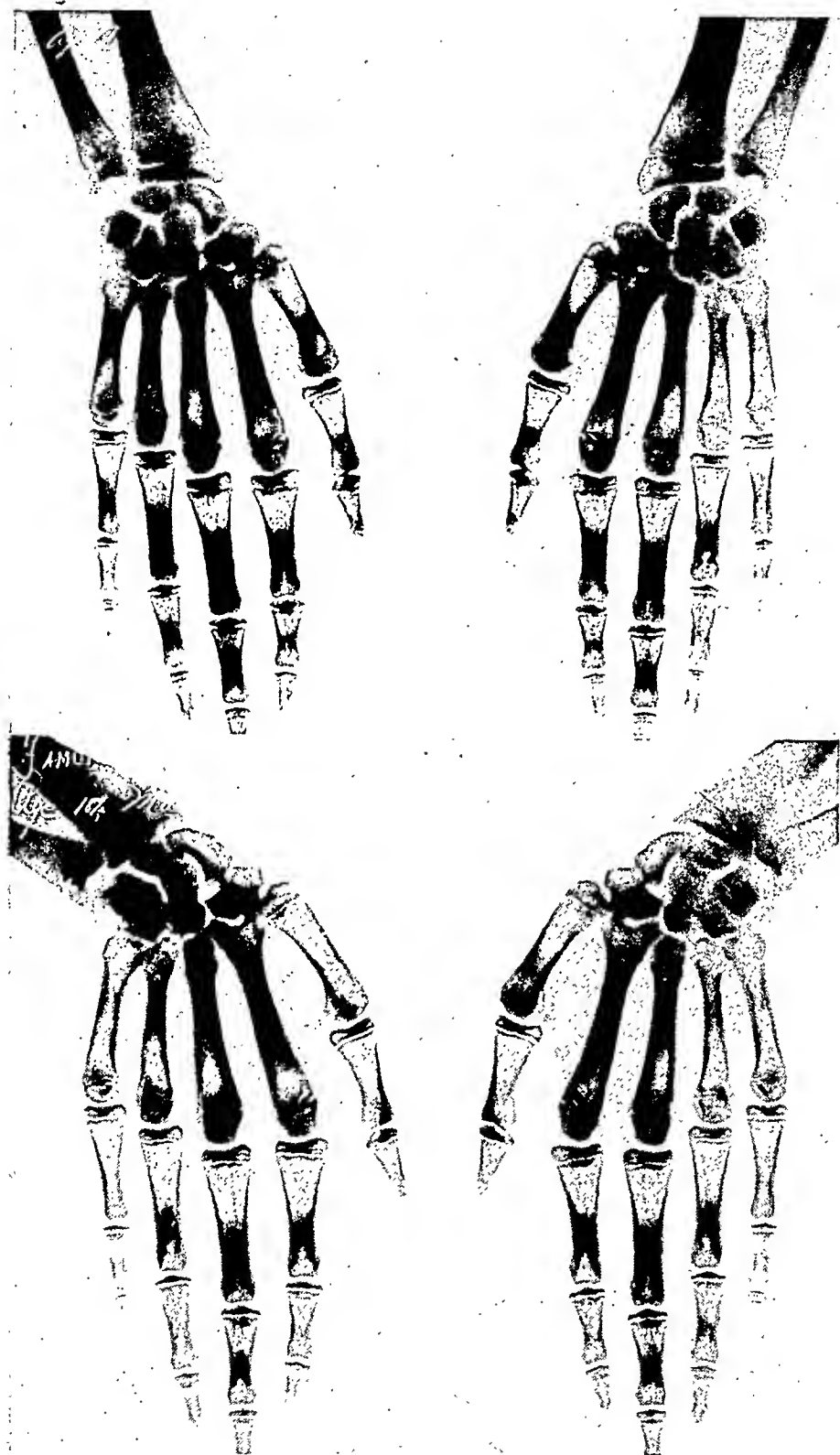
advanced for this age period. The average age of the children in this group was 12 years, the youngest being 3 1/2 and the oldest 17 years of age.

The average duration of therapy was seven months, the range being from two to twenty-four months. The average total amount of chorionic gonadotropin administered to a patient was 33,000 I.U. The variations were from 9,000 to 131,000 R.U. From 200 to 500 I.U. were administered two or three times a week.

The initial roentgen studies showed normal bone density and development in 14 children. Delayed epiphyseal union with a mild degree of decreased bone density was observed in 4 children. Decreased structural density without a delay in epiphyseal union was present in one instance. Following therapy there was an increase in bone length without acceleration of epiphyseal union in 15 cases. Delay in epiphyseal union persisted in 2 out of 4 children and acceleration of bone maturation was present in the other 2. These 2 children were treated for longer periods than any others in this group. One, aged 3 1/2, was treated for twenty-three months, the other, aged 4, for twenty-four months. The total amount of chorionic gonadotropin was correspondingly large, 93,500 I.U. being given to one child and 131,000 I.U. to the other. In spite of the advanced state of bone growth and increased structural density, the epiphyses have remained ununited, and clinically the children continued to show accelerated growth two years after cessation of therapy. The unusually prolonged period of therapy and the large amount of hormone used in these 2 cases were rather exceptional and were employed in an effort to correct an extreme degree of hypogenitalism and cryptorchidism (Tables I and II).

The majority of the children in this group showed normal skeletal growth and development with a tendency to accelerated lengthening of the long bones. The roentgen findings were borne out by the clinical progress. In the majority of cases there was a tendency to a spurt in growth rate

⁸ Growth Complex (Ayerst), 100 R.U. per c.c.



Figs. 3 and 4. Case II: Results of growth hormone therapy.

Fig. 3 (above). Age 17 years. Height 60 1/2 in. Weight 82 lb. Skeletal age 14 years 9 months. Retarded epiphyseal union. Mineralization light. No scorings on radius.

Fig. 4 (below). Age 18 1/2 years. Height 64 1/2 in. Weight 112 1/2 lb. Skeletal age 15 years 3 months. Note increase in vertical axis of metacarpals and phalanges. No advance in epiphyseal union and no increase in bone density. No scorings on radius.

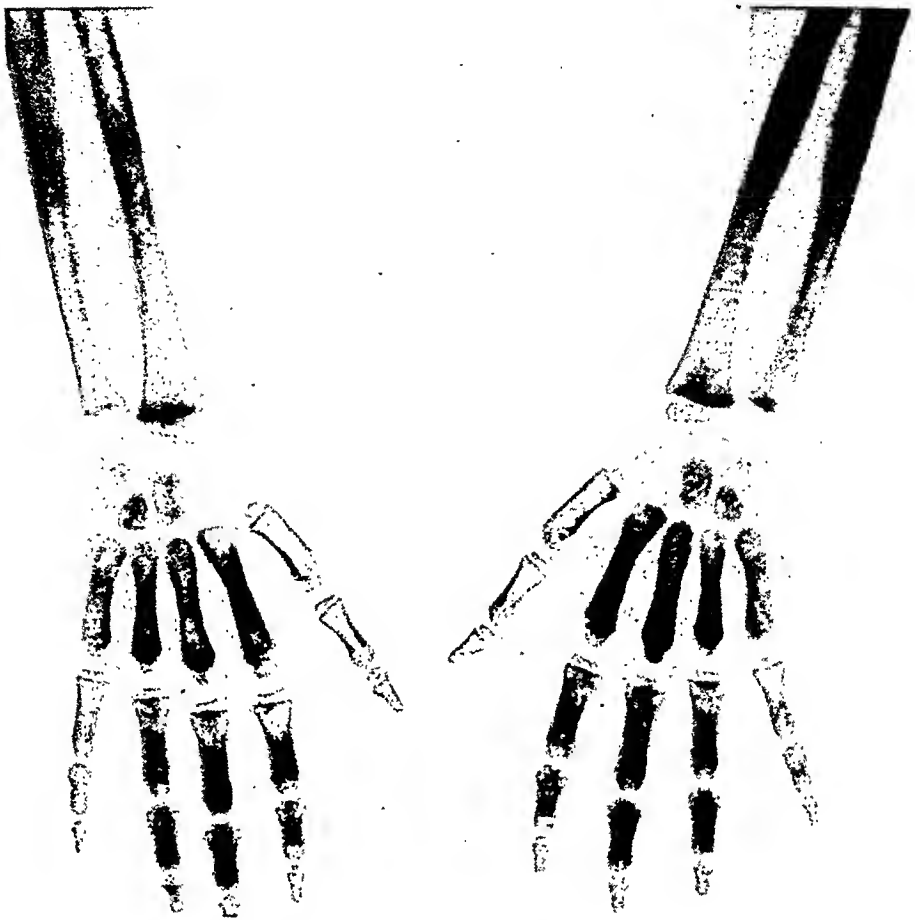


Fig. 5. Case III: Age 3 1/2 years. Height 35 in. Weight 38 lb. Skeletal age 3 to 4 years. Normal centers of ossification. Mineralization light. No scorings on radius.

either during the course of therapy or within a year after cessation of therapy.

CASE III: R. L., male, age 3 1/2 years, height 35 in., weight 38 lb., was admitted to the Endocrine Clinic on Oct. 10, 1937, showing bilateral cryptorchidism and hypogenitalism, mental retardation, and a speech defect. The roentgen studies of the long bones revealed the centers of ossification to be normal, but there was a light degree of mineralization (Fig. 5).

Therapy with chorionic gonadotropin was carried out over a period of two years, with varying intervals of rest. The total amount of chorionic gonadotropin administered was 93,500 I.U. X-ray examination of the hands and wrists at the completion of therapy showed rapid bone growth and maturation. The size and density of the bones were about a year and a half in advance of the actual age, which was then 5 1/2 years (Fig. 6). At this time the child's height was 45 1/2 in. and his weight was 41 lb. The therapy was therefore discontinued for two years. Chorionic gonadotropin therapy also stimulated genital development and descent of the testes. During the four-year period of observation and treatment the patient

grew 18 1/2 in., which may be considered a marked spurt in somatic growth. However, because the withdrawal of therapy was followed by a regression in the genital development and the retraction of the testes into the inguinal canal, it was decided to administer a short course of testosterone therapy in order to improve the weight, genital status, and general vitality, which were below par. Accordingly, testosterone propionate was given in doses of 10 to 25 mg. once or twice a week, a total of 700 mg. being administered over a period of seven months. Clinically, a gain in weight and improvement in vitality and genital development were observed. There was a further increase in skeletal growth and epiphyseal development as revealed by the x-ray. All the carpal bones were present and well developed, and no tendency to premature epiphyseal union was apparent. The skeletal age was about 11 years, an advance of a year and a half over the actual age (Fig. 7). At this time the height was 56 3/4 in., the weight 69 lb. The boy became mentally more alert and sociable, and there was some improvement in his speech.

In this case, intensive and prolonged chorionic gonadotropin therapy stimulated

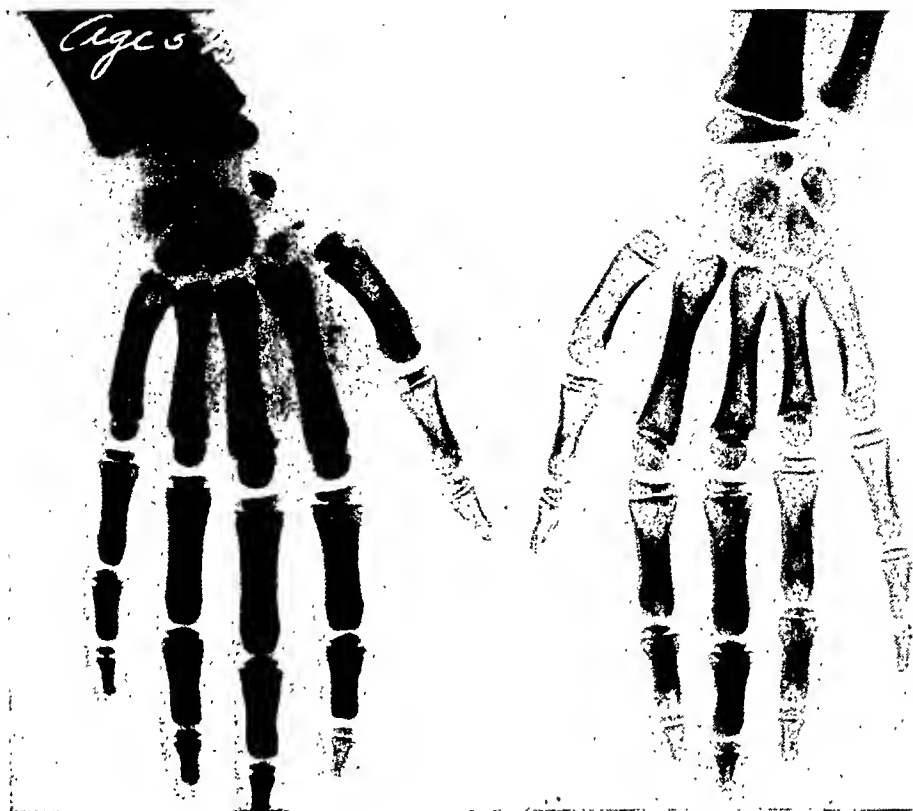


Fig. 6. Case III, following chorionic gonadotropin therapy. Age 5 1/2 years. Height 45 1/2 in. Weight 41 lb. Skeletal age about 7 years. Note rapid advance in appearance of ossification centers and number of carpal bones. Mineralization heavy. No scorings on radius.

somatic and genital growth and development. Skeletal growth was rapid and progressed in advance of the actual age. During the two years following cessation of therapy, body and bone growth proceeded at a favorable rate. This progress also continued during and following testosterone therapy. Five and one-half years after the original roentgen studies were made, bone growth, structural density, and development were about a year and a half in advance of the chronological age. When last observed, the child continued to grow at a satisfactory rate.

TESTOSTERONE THERAPY

Roentgen studies were carried out on 18 children who received testosterone therapy for growth deficiency and hypogenitalism. Normal epiphyseal union and skeletal structural density were observed in 7 children. There was a delay in epiphyseal

union in 9 children; in 2 of these there was also evidence of decreased structural density, and 2 others of this group showed a decrease in bone density without a delay in epiphyseal union (Table II).

The children were treated for periods ranging from two and a half to fourteen months, each receiving a total of 300 to 1,900 mg. of testosterone propionate, with the exception of one eunuchoid boy, aged 18, who was treated over a period of four years and received a total of 5,050 mg. of testosterone propionate by injection, methyl testosterone orally, and implanted testosterone.

Testosterone therapy was administered in the following manner: by injection, 10 to 25 mg. testosterone propionate twice weekly; by implantation, 300 to 500 mg. of testosterone at each implantation; orally, methyl testosterone tablets, 10 mg. twice daily. The clinical response in most

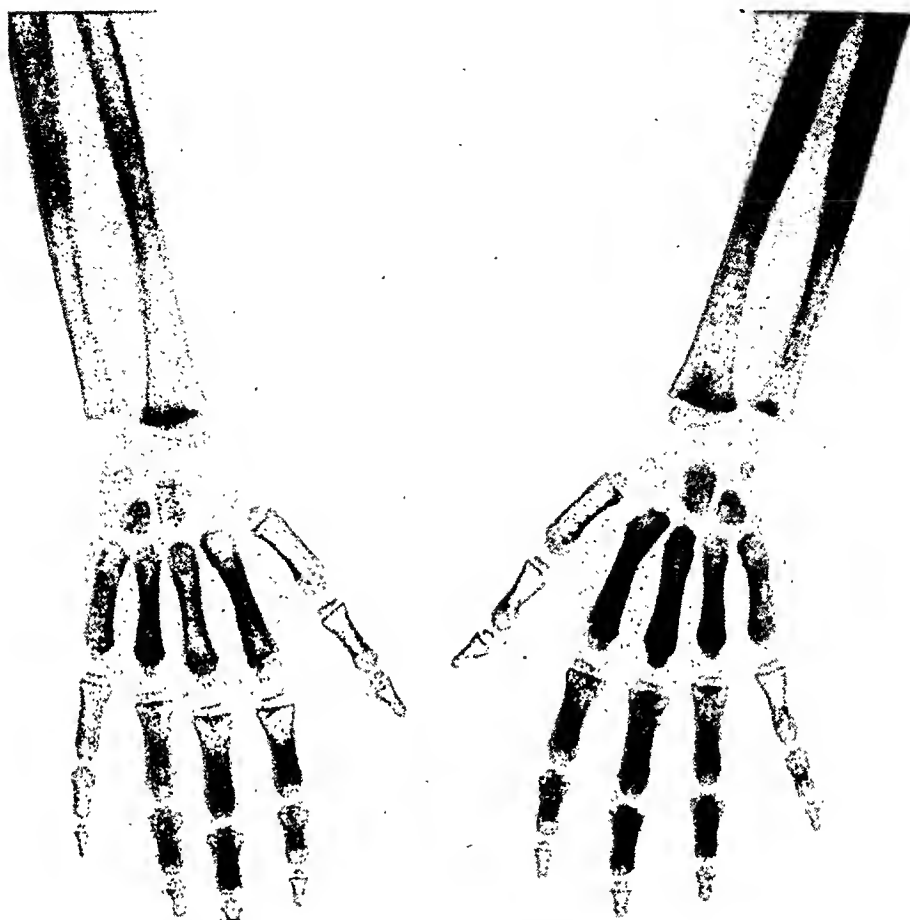


Fig. 5. Case III: Age 3 1/2 years. Height 35 in. Weight 38 lb. Skeletal age 3 to 4 years. Normal centers of ossification. Mineralization light. No scorings on radius.

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Our clinical findings correspond to those reported in experimental studies. Rubinstein and Solomon (13) found that small doses of testosterone propionate administered to animals caused an initial spurt in growth. Larger amounts caused calcification and premature aging of epiphyseal cartilage with cessation of growth, as noted also by Silberberg and Silberberg (16 *e, f*). The amounts of testosterone propionate employed in these animal experiments were, in proportion to body weight, several hundred times greater than the amounts employed by us and other physicians clinically. From the physiological, economical, and practical points of view, it would not be necessary to administer testosterone to man in dosages comparable to those used in animals, since the amounts which we employed gave all the results desired.

The dosages of testosterone employed by us (4) and others (1, 2, 5, 11, 12, 19) over short periods of time resulted in the same initial stage of bone growth stimulation produced in experimental animals (13). While testosterone was administered by us in small to moderate dosages, within the range of safety, careful supervision and frequent physical examinations, especially of the genitalia, were made during the course of therapy in order to avoid bringing on undesirable excessive genital development. Roentgen studies were carried out at intervals of three to four months. Therapy was discontinued at once if any evidence of excessive acceleration of structural density or epiphyseal union was noted.

CASE IV: S. S., white male, age 17, height 63 3/4 in., weight 123 lb., was admitted to the Endocrine Clinic, with hypogonadism and eunuchoidism. His height was normal for his age, yet his body configuration and measurements were eunuchoid, his voice was high-pitched, and his genitalia were underdeveloped. He was taciturn and self-conscious and easily fatigued. Roentgen studies of his wrists and hands revealed the bone structure to be normal in size and density. There was, however, a retardation in epiphyseal union of at least two years (Fig. 8).

A short period of therapy with chorionic gonadotropin failed to stimulate genital development, and testosterone therapy was initiated and carried

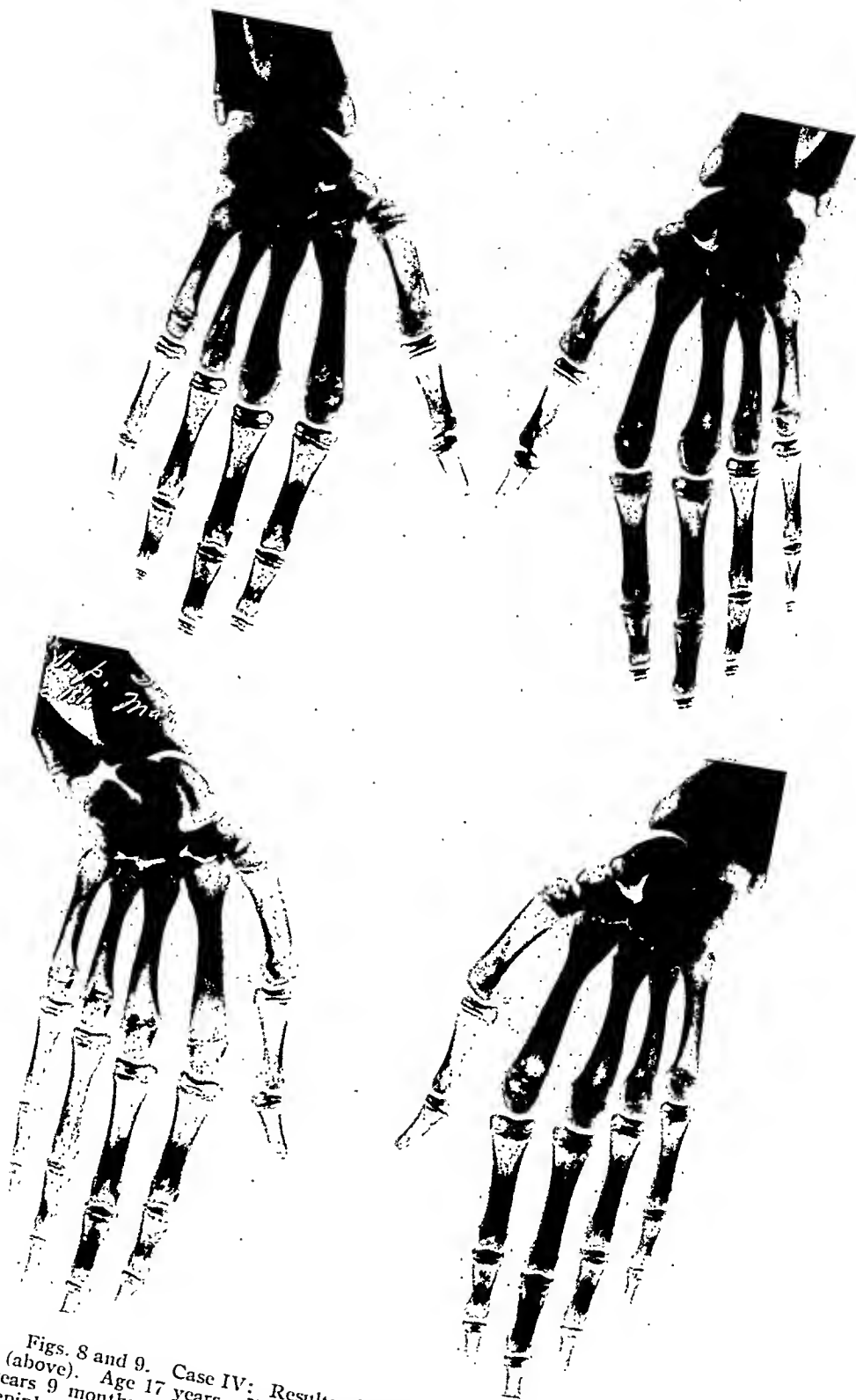
out for a period of four months, during which time 800 mg. of testosterone propionate was administered. The therapy resulted in a rapid genital development and an increase in pubic hair, deepening of the voice, and an increase in growth rate of 2 1/4 in. The patient's vitality increased greatly; he became more assured and sociable. Roentgen studies at the completion of therapy and one year later, at the age of 18 1/2, showed an increase in bone length but no change in epiphyseal union (Fig. 9). Testosterone therapy stimulated growth of the long bones in length, but did not affect epiphyseal union.

SUMMARY AND CONCLUSIONS

1. The influence of hormonal therapy on bone growth and development has been observed in 81 children, 18 of whom were treated with thyroid substance, 26 with anterior pituitary growth extract, 19 with chorionic gonadotropin, and 18 with testosterone.

2. Thyroid therapy tended to improve bone density and epiphyseal union. Before therapy was instituted delayed epiphyseal union accompanied by varying degrees of decreased structural density was noted in 6 children, while decreased structural density without delay in epiphyseal union was shown in 4 others. At the conclusion of therapy the bone density was normal in all children, but in 5 the delay in epiphyseal union persisted. There was an improvement in growth rate, physical development, and mental alertness. Best results were obtained with children where a clear indication of thyroid deficiency previously existed.

3. Therapy with anterior pituitary growth extract (26 children) did not yield any conclusive evidence of changes in skeletal growth and development in the majority of our patients. In 4 of the older group of children (14 to 16 years) skeletal maturation and epiphyseal union seemed to progress beyond the normal rates, although such a tendency already existed in 3 children before therapy was initiated. In 11 children with delayed epiphyseal union no effect was produced on bone maturation or epiphyseal union. At the conclusion of therapy and two months to two years following therapy, the epiphyses remained ununited. In the remaining 11



Figs. 8 and 9. Case IV: Results of testosterone therapy.
 Fig. 8 (above). Age 17 years. Height 63 $\frac{3}{4}$ in. Weight 123 lb. Skeletal age 14 years 9 months. Bone structure normal as regards size and density. Delayed epiphyseal union. No scorings on radius.
 Fig. 9 (below). Age 18 $\frac{1}{2}$ years. Height 66 in. Weight 135 lb. Skeletal age 16 years 9 months. Retarded epiphyseal union. No scorings on radius.

children of this group, with fairly normal findings at the start of therapy, bone growth and development proceeded normally. Clinically the growth rate was improved in 8 cases and maintained in 18. There was, however, a general improvement in vitality, muscle tone, and mental alertness in the majority of the children.

4. Chorionic gonadotropin therapy stimulated bone growth in the longitudinal axis but did not accelerate epiphyseal union, bone maturation, or density in the majority of the cases. Only 2 children treated intensively over a period of two years showed increased bone maturation and density. Seventeen children responded by an increase in growth rate; 2 children maintained their original rate of growth. All children showed an improvement in genital development, muscular tone, mental alertness, and social adjustment. There was also a loss of weight in the majority of the obese children.

5. Testosterone therapy showed a tendency to accelerate skeletal growth in length to a somewhat greater degree than chorionic gonadotropin. No hastening of epiphyseal union was observed. A moderate degree of increased bone density was noted in 3 out of 18 children. Clinically 16 children showed an increase in growth rate and 2 maintained their original rate of growth. All children showed improvement in genital development, muscular tone, and self assurance. A gain in weight was noted in the majority. The rapid genital development caused by testosterone therapy necessitated frequent examinations and interruptions of therapy except in 2 eunuchoid boys, who were treated almost continuously.

6. Before hormonal therapy all of the children presented various psychological maladjustments: most of them were shy, self-conscious, and unsociable; others were resentful towards their parents, guardians, or society in general. Following successful endocrine therapy, with improvement in growth and genital and muscular development, there was a tendency to improvement in mental and emotional stability.

NOTE: The authors wish to express their appreciation to Doctors Martin and Ruth Silberberg of the Department of Pathology of the New York University College of Medicine for their valuable suggestions.

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Pituitrin for Concentrating Diodrast in Excretion Urography¹

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THE PURPOSE of this study was to attempt to improve present methods of concentrating diodrast in intravenous urography and to observe the effects of the antidiuretic principle of posterior pituitary extract in relation to the excretion of that foreign material.

In the preparation of a subject for intravenous urography, as for the performance of the urine concentration test, a period of dehydration is necessary. In each instance the strict co-operation of the subject is required for uniform success. Because of this variable, rather elaborate procedures are frequently used to insure maximum dehydration. Elimination of this preliminary preparation in favor of a simple standard procedure which does not require co-operation of the subject, does not depend upon the state of body hydration, can be done in a short time at any time of the day, and yields consistent results within a narrow range, seems a desirable end to be gained.

The antidiuretic effect obtained by the administration of posterior pituitary extract has been utilized as a means of concentrating the urine in renal function tests. The published results to date seem highly significant (1-5). It has been shown that a considerable reduction in urinary output can be obtained in normal persons (2, 3) and in those suffering from renal disease or diabetes insipidus, as well as in animals (6, 7). Without entering upon a discussion of the comparative physiology of the antidiuretic effect, it

appears reasonably certain that, at least in mammals, it is the result of increased reabsorption of water in the proximal convoluted tubules and thin portion of Henle's loop (8-10) and is accompanied by an increased urinary output of chloride (3), apparently the result of decreased absorption of that ion by the tubules (8). Moreover, experiments in mammals, by Wakim *et al.* (11), showed no alteration of renal blood flow or blood pressure after subcutaneous administration of pituitrin, furthering the notion of tubular reabsorption of water as the mechanism of antidiuresis.

PROCEDURE

Fifteen patients were submitted to intravenous excretory urography for visualization of renal pelves, calices, and upper ureters. Each patient was first examined with the usual dehydration technic, roentgenograms being made at seven-, fifteen-, and thirty-minute intervals following the intravenous injection of 20 c.c. of 35 per cent diodrast. Pressure across the lower ureters was maintained firmly enough to prevent escape of the diodrast into the bladder. In this series of examinations it was not always possible to compress the ureters completely. The escape of some of the diodrast into the bladder caused a loss of density and detail in the upper urinary tract shadows, but in no case was this factor taken into consideration in judging in favor of the pituitrin effect. Follow-up films over renal, ureteral, and bladder areas were made after release of the pressure.

After establishing the condition of the urinary tract with the patient dehydrated,

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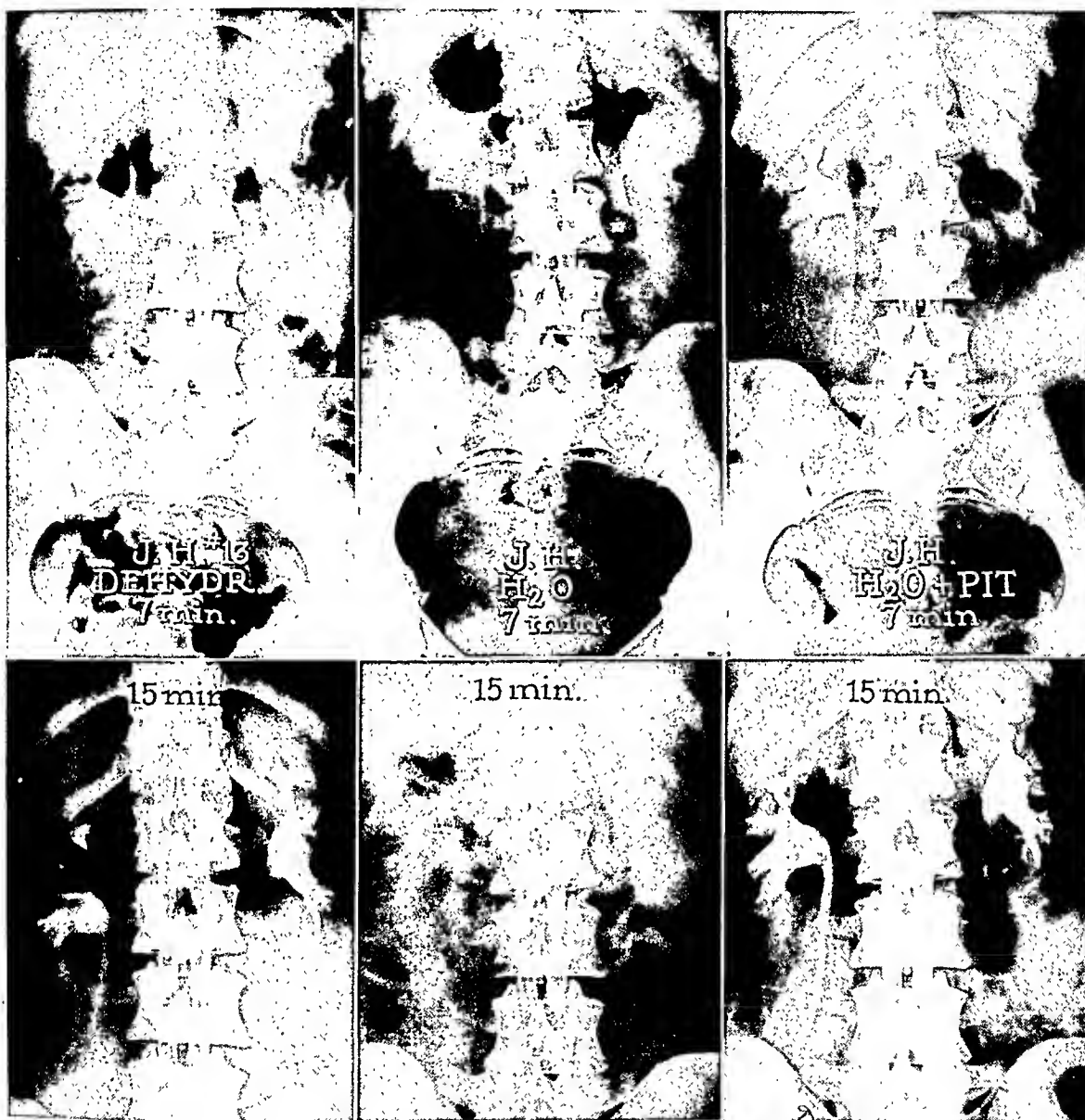


Fig. 1. Patient No. 13. Visualization of the upper urinary tract. On the left, the upper and lower films represent seven- and fifteen-minute exposures after diodrast injection, with patient dehydrated.

The middle films show corresponding seven- and fifteen-minute exposures, on the same patient, after diodrast injection following hydration by 12 ounces of water orally. Poor density and detail result.

The films to the right disclose the good visualization obtained by injection of 1.5 c.c. of pituitary extract, even after 18 ounces of water had been taken by mouth. The concentrating effect of the pituitrin on the urine provides better density and detail of the urinary tract shadows.

12 of the group were examined a second time. For this second examination the patient came unprepared and was given 0.5 c.c. of surgical pituitrin subcutaneously; fifteen minutes later, after emptying the bladder, he was given 18 ounces of water orally. This large quantity of water was given solely for the purpose of putting the antidiuretic effect of pituitrin to a severe

test. One hour later (one hour and fifteen minutes after pituitrin), 20 c.c. of diodrast was injected intravenously and films were exposed at intervals of seven and fifteen minutes. This time interval between the injection of pituitrin and diodrast was selected on the basis of Sodeman and Engelhardt's experimental studies of urine specific gravity. The shadows of the

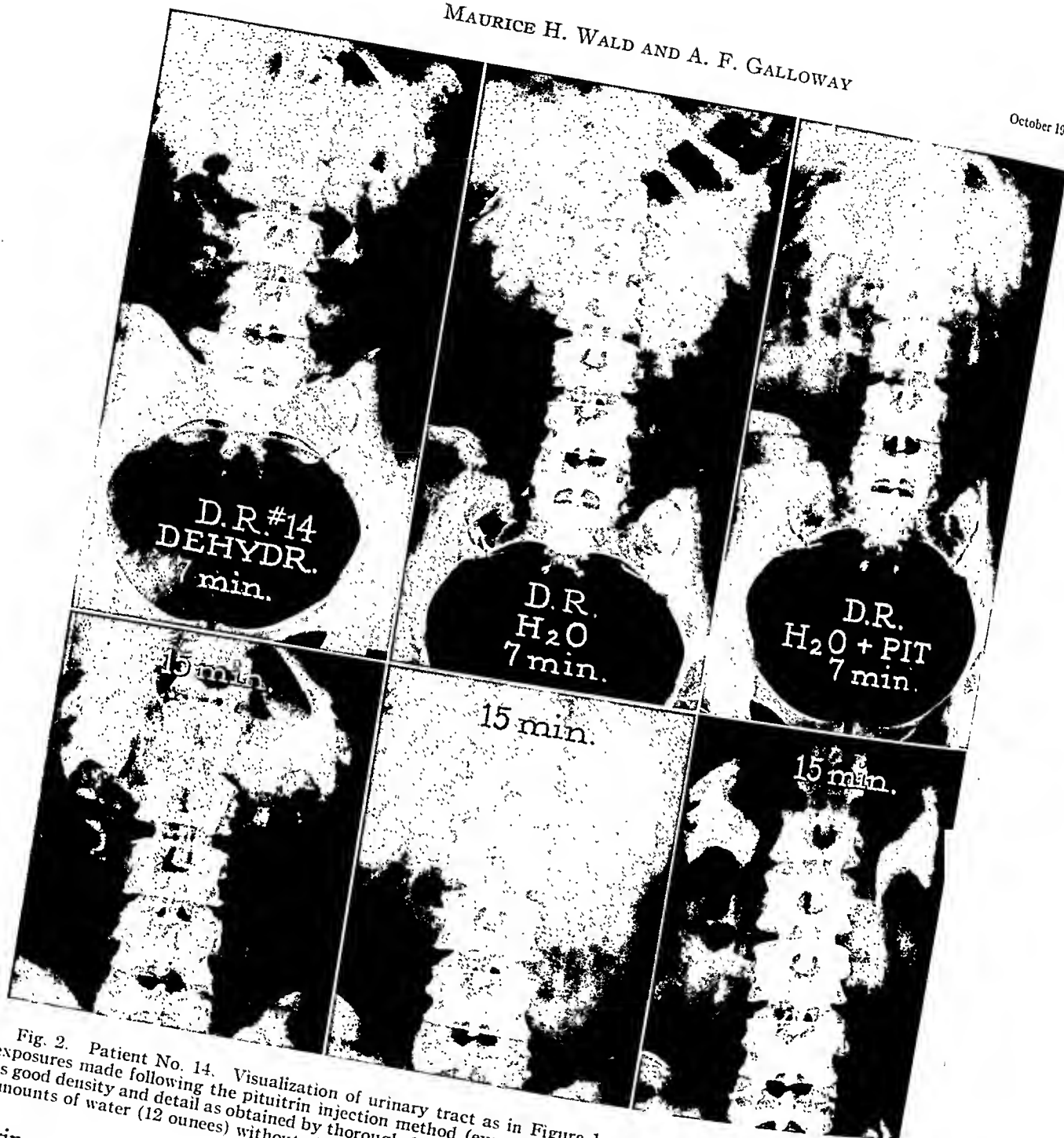


Fig. 2. Patient No. 14. Visualization of urinary tract as in Figure 1. Again the seven- and fifteen-minute exposures made following the pituitrin injection method (even after the ingestion of 18 ounces of water) show as good density and detail as obtained by thorough dehydration, and better by far than gained by drinking smaller amounts of water (12 ounces) without pituitrin injection.

urinary tract were compared for density and detail with those on the corresponding seven- and fifteen-minute films in the preliminary study.

Part of the group of patients was studied a third time. Eight of those previously examined were purposely hydrated with 12 ounces of water an hour before the injection of 20 c.c. of diodrast. Again seven- and

fifteen-minute films were made in the same manner as in the original study. Three others of the original group were re-examined without any preparation whatever, and seven- and fifteen-minute films were taken to compare with those of the preliminary study done with dehydration. Following this, another group of 24 patients was examined to whom only 0.2 c.c.

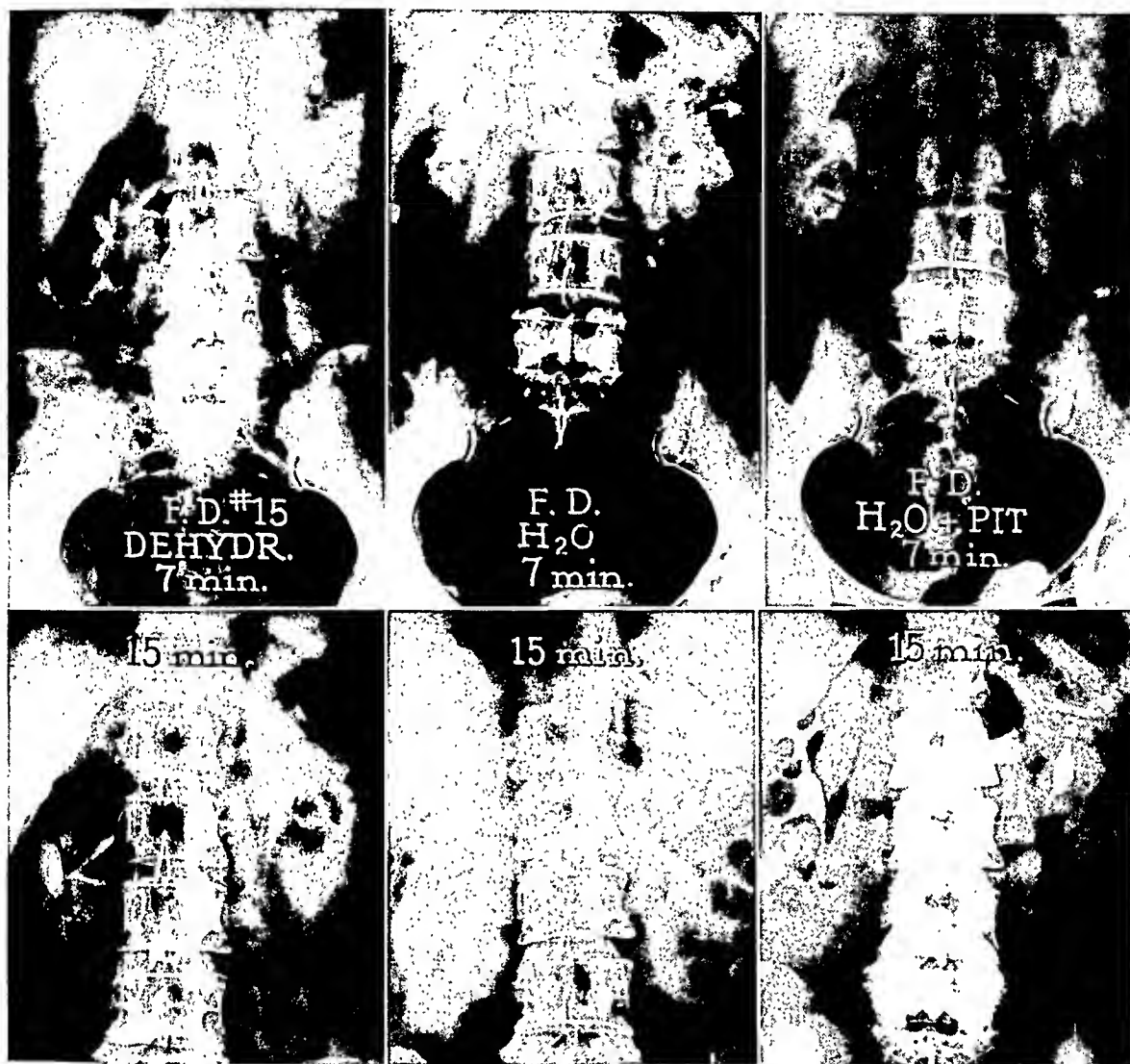


Fig. 3. Patient No. 15. Visualization of urinary tract after the three methods of preparation shown in Figures 1 and 2. Again, better density and detail were obtained on the seven- and fifteen-minute exposures by using pituitrin, even after excessive amounts (18 ounces) of water by mouth.

pituitrin was administered. These patients came wholly unprepared, after breakfasts which included fluids in quantities from 3 to 12 ounces. On theoretical grounds the smaller dosage should give adequate antidiuresis, with a lessened tendency toward unpleasant side actions.

RESULTS²

1. Of 15 patients subjected to intravenous urography after preparation by a standard dehydration technic, 11 showed good visualization, three showed fair visual-

ization, and in one, who had a right ureteropelvic obstruction, visualization was poor.

2. Of 12 patients subjected to a second intravenous pyelography, after administration of pituitrin, all save one showed visualization equal to or better than that shown previously. (The patient in whom visualization was poor was very small and probably could not concentrate the relatively large quantity of water given.)

3. Of the 8 patients subjected to a third urography without preparation of any sort except the administration of a large quantity of water, 3 showed good visualiza-

² See also Table I.

TABLE I: DEGREE OF VISUALIZATION OF URINARY TRACT OBTAINED BY INTRAVENOUS DIODRAST INJECTION AFTER VARIOUS PREPARATORY TECHNIQS

Patient	Dehydration	Water and Pituitrin	Water	No Preparation	Remarks
1	Fair	Fair to good	Fair	.....	Lower left ureteral stone
2	Fair	Fair (7 min.)	.....	.....	Left ureteral leak on first study
		Good (15 min.)			
3	Good	Good	Good	.....	.....
4	Good	Good	.....	.....	.....
5	Good	Good	Fair	.....	.....
6	Good	Very good	Good	.....	.....
7	Good	Poor	.....	.....	Small patient
8	Good	Good	Poor (7 min.)	.....	.....
			Good (15 min.)		
9	Poor	.....	.....	Fair	.....
10	Good	.....	.....	Fair	Pregnant
11	Good	Good	.....	.....	.....
12	Fair	.....	.....	Good	Right uretero-pelvic obstruction
13	Good	Good	Poor	.....	.....
14	Good	Good	Fair	.....	Renal ptosis
15	Good	Good	Poor	.....	.....

tion equal to that of the original examination.

4. In another group of 3 patients subjected to urography without preparation of any sort, 2 had as good or better visualization than on the preliminary study.

5. Of the group of 24 patients subjected to urography after the administration of 0.2 c.c. pituitrin but without preparation of any other type, 15 showed good concentration of dye, 6 a fair concentration, and 3 gave poor visualizations.

DISCUSSION

Patients with coronary artery disease and pregnant women were not given pituitrin. Two patients had mild reactions from 0.5 c.c. pituitrin in the form of temporary diarrhea, while one of the 24 receiving 0.2 c.c. suffered transient weakness, nausea, and blanching of the skin. No other untoward reactions were observed. Blood pressures were not recorded.

It is noteworthy that of the original group of 15 patients, half of those who were given either 12 ounces of water or came unprepared (see Table I, columns headed Water and No Preparation) still had good urinary tract visualization although no pituitrin was used. The reason for this probably lies in the fact that the study was carried on in the hottest part of the summer. Moreover, some patients unwittingly restricted fluid and food intake contrary to

instructions, because they had done so for the previous study. We believe they were sufficiently dehydrated to allow for good concentration of diodrast even after ingestion of 12 ounces of water. These variable factors were eliminated in our second group of 24 patients, all of whom were studied during the winter months and came uninstructed and unprepared in any way.

Regarding the question of the influence of the pituitrin upon the bowel and its contents, and the possible relation of this to the quality of the urographic visualization, we noted that 0.5 c.c. of pituitrin caused a shifting of bowel content and occasionally a watery stool. Frequently segments of the colon became more distended with gas, and where this occurred the contrast between these superimposed gas shadows and the renal pelves, calices, ureters, and surrounding structures accentuated their visualization. The effect of the pituitrin was judged on the basis of actual diodrast density and not on the basis of contrast due to superimposed gas shadows.

It should be emphasized that the large quantities of water taken before the administration of pituitrin were given merely to put the antidiuretic effect to a severe test and not because this is an essential for routine procedure. The ordinary radiologic procedure would simply include the administration of pituitrin one to two hours

before the injection of diodrast without preliminary preparation of the patient. On the other hand, pituitrin injection may be somewhat dangerous to a patient already severely dehydrated, and such persons should be given fluids if pituitrin is to be used for routine examination.

Although no quantitative interpretation can be made from these results, it may be concluded that there is no significant sustained alteration in renal blood flow as a result of the influence of the anti-diuretic hormone, since diodrast appears promptly in the urine. It follows that tubular reabsorption is the mechanism of pituitrin antidiuresis. These data are consistent with the work of others (9, 11, 12) who have arrived at these conclusions by more direct and quantitative methods.

SUMMARY AND CONCLUSIONS

One-half cubic centimeter (10 units) of pituitrin administered subcutaneously will suppress 18 ounces of water ingested at the same time in an adult patient of average weight. By the use of pituitrin, the density and detail of the upper urinary tract shadows cast by diodrast administered intravenously can be improved without harm to the patient, although he may be markedly hydrated. The use of such a technic is of particular value when

a prompt study is desired in a patient not previously prepared.

While the tendency toward unpleasant side actions from the injection of pituitrin is lessened by the use of a smaller dose (0.2 c.c.), the larger dose (0.5 c.c.) insures a greater probability of good visualization.

NOTE: The diodrast used in these studies was generously supplied by the Department of Medical Research, Winthrop Chemical Co., Inc.

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Angiocardiography¹

Anatomy of the Heart in Health and Disease

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ANGIOCARDIOGRAPHY had its beginning in 1928, when Robb and Weiss (1) started their studies on cardiac physiology and circulation time in order to ascertain whether visualization of the heart was feasible. Angiocardiography has elucidated many enigmas of the heart and great vessels and has also made it possible to differentiate the vascular from the non-vascular lesions of the mediastinum.

In 1931 Forssmann of Germany (2) succeeded in demonstrating the right auricle by introducing into it an iodine preparation, by means of a ureteral catheter, through the veins of the right arm. Subsequent investigators have employed this procedure or some modification of it for demonstration of the cardiac chambers and the great vessels leading to and from the heart. Egas Moniz of Portugal (3) and Ravina (4) and others in France used Forssmann's technic to visualize the pulmonary vessels.

In the Western hemisphere, the pioneers in the roentgen demonstration of the abnormalities of the heart and great vessels were Castellanos and Pereiras of Cuba (5-14). Their work, begun in 1931, antedates all work of record in the United States. Their method was devised for infants and children, living and dead, and did not differ fundamentally from that now in use. They threaded a Lindemann cannula into the vein of the arm, preferably the right, and injected 10 to 20 c.c. of a 35 per cent solution of parabrodil. In their later work, however, uroselectan B

was used with satisfactory results, not only in the newborn and infants, but also in older children. By their method they visualized only the right heart and pulmonary tree. The left side was demonstrable only if an interauricular or interventricular septal defect was present. In many instances, Castellanos and Pereiras had the opportunity of comparing their roentgen observations with postmortem findings.

In the United States Robb and Steinberg in 1938 (15) described a practical method for the visualization of the heart and great vessels. Robb, five years earlier (16), while in Boston, had himself injected with 20 c.c. of uroselectan, hoping to be able to visualize his own heart and vessels by fluoroscopy. As a result of this injection an extensive thrombophlebitis of the vessels of his arm resulted, and the work was temporarily discontinued.

The recent literature contains more than a hundred papers on angiocardiography. They range in scope from descriptions of technic to accounts of the demonstration of congenital malformations and differential diagnosis of mediastinal lesions. Notable among the writers are Sussman, Steinberg and Grishman (17, 18, 19) whose work on congenital lesions, intrapulmonary lesions, and technic constitute a valuable contribution in the field of angiocardiography.

ANATOMY OF THE NORMAL HEART

We have found variations from the recognized and accepted radiographic picture of the normal cardiac silhouette. This type of examination affords a means of

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determining the size and shape of the heart, the presence or absence of cardiac hypertrophy, chamber enlargement, or both; also, the location of the valves and the position of the chambers, the ventricular conus, the pulmonary aorta and its branches, the aorta, and the border-forming structures of the cardiac silhouette.



Fig. 1. Postero-anterior view, showing left innominate vein, superior vena cava, right auricle, right ventricle, ventricular conus, pulmonary aorta, right and left pulmonary arteries.

Postero-Anterior Position: Figure 1 is a postero-anterior view. (1) The superior vena cava, right auricle and ventricle, and the pulmonary aorta appear as a "U"-shaped structure occupying about one-half the frontal cardiac silhouette, seldom extending beyond the left lateral margin of the vertebral column. (2) The superior vena cava occupies the upper right margin of the cardiac silhouette. It may extend down to the diaphragm before emptying into the right auricle, constituting the major portion of the right cardiac border. (3) Usually the right auricle forms the lowermost part of the right border, extending down to the dome of the diaphragm. (4) The right ventricle has a short horizontal



Fig. 2. Postero-anterior view, showing left innominate vein, superior vena cava, right auricle, right ventricle, right ventricular apex, ventricular conus, area of pulmonary valves, pulmonary aorta, bifurcation into left and right pulmonary arteries.

and a rather long vertical portion, the uppermost part representing the area of the conus arteriosus (Fig. 2). (5) The tricuspid valve area may be identified by a constriction between the auricle and ventricle, giving a butterfly appearance to the right heart (Fig. 3). (6) Immediately above the conus is a constriction representing the region of the pulmonary valves, and above it is the pulmonary aorta. The lowermost portion of the right border of the cardiac silhouette, on occasion, may contain a non-opacified area, which on kymographic examination will show pulsations with ventricular characteristics. It is our opinion that this non-opacified area is occupied by the inferior vena cava.

The right heart does not occupy more than about one-half of the cardiac silhouette. The ascending aorta, normally, does not form part of the right cardiac border. This is made up of the superior vena cava and the right auricle, with the inferior vena cava participating at times in forming the lowermost portion. The right



Fig. 3. Postero-anterior view, showing left innominate vein, superior vena cava, right auricle, tricuspid area, right ventricle, ventricular conus, pulmonary aorta, bifurcation into left and right pulmonary arteries.



ventricle is situated deep within the cardiac silhouette and is far removed from the left cardiac border. The ventricular conus or conus arteriosus is a centrally located structure and does not participate in forming any portion of the left border of the cardiac silhouette. The pulmonary aorta may at times reach the left cardiac border and participate in its formation. The left pulmonary artery frequently forms part of the left middle cardiac segment. This artery is situated at a slightly higher level than the right. The interventricular septum is vertical and convex to the right. The apex of the right ventricle forms an acute angle far removed from the cardiac apex.

The left heart, when opacified, assumes a figure-of-eight form, obliquely situated at an angle of about 30° from the horizontal (Fig. 4). The left auricular shadow is circular in outline, is disposed more to the right than to the left, and does not form part of either cardiac border except for the left auricular appendage, which may be

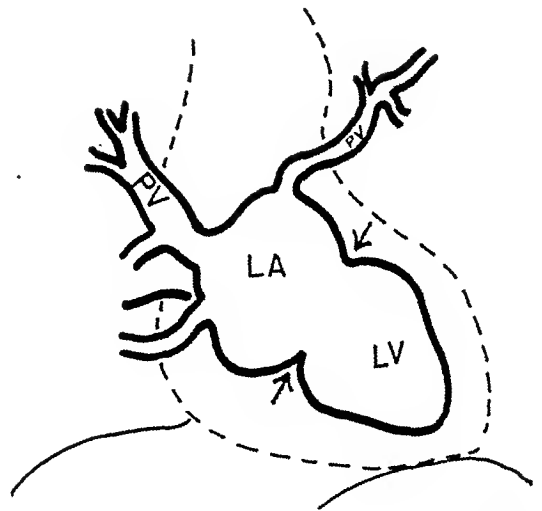


Fig. 4. Postero-anterior view of left heart. Note the figure-of-eight form of the left heart. The auricular shadow is situated to the right of the left ventricular shadow and is non-border-forming. Note mitral area.

border-forming on the left side. The left ventricular shadow is oval, occupying the major portion of the left half of the heart. A constriction between the auricle and ventricle is the location of the mitral ring or annulus.

The ascending aorta is the continuation of the left ventricle, arising well within the right half of the cardiac silhouette. It



Fig. 5. Postero-anterior view, showing left ventricle in systole and the aorta outlined.

proceeds slightly upward and to the right, then bends toward the left as it passes upward and across the spine, bending on itself and descending along the left lateral border of the spine. The aorta (Fig. 5) forms no part of the right cardiac border, except when tortuous, elongated, or dilated.

The left cardiac border is formed from above downward by the aorta, the middle cardiac segment, and the left ventricle. The middle cardiac segment is the area between the aortic arch and the base of the left ventricle. It is at times composed of the pulmonary aorta as it ascends, just before it bifurcates, and above it the left pulmonary artery. More often, however, this latter vessel is the prominent structure in this area. The descending aorta may also be the border-forming structure of the middle cardiac segment. At the junction of the lower portion of the middle cardiac segment and the base of the left ventricle is a small non-opacified area, which we believe to be the left auricular appendage.

In the supracardiac area, the superior vena cava is to the right of the aorta. The

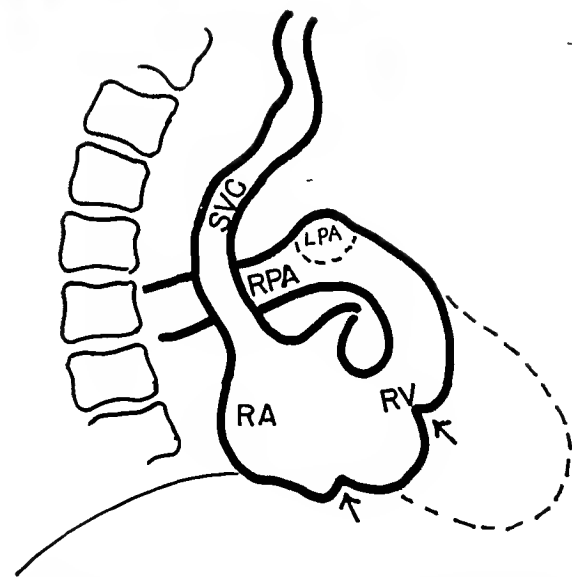


Fig. 6. Right anterior oblique view, showing superior vena cava, right auricle, tricuspid area, right ventricle, ventricular conus, pulmonary aorta, left pulmonary artery.

ascending and descending portions of the aorta may be either superimposed, adjacent to, or separated from each other.

Right Anterior Oblique Position: The superior vena cava, the right auricle, the right ventricle, and the pulmonary aorta present a "U"-shaped structure in the postero-anterior view. This same "U"-



Fig. 7. Right anterior oblique view, showing left heart, aorta, left auricle, mitral area, left ventricle.

shaped structure is visualized in the right anterior oblique position (Fig. 6), presenting a more curved appearance with a wider separation of the limbs of the "U." In this position the superior vena cava can be traced into the right auricle, which rests on the diaphragm and does not encroach upon the retrocardiac space. The right ventricle forms the horizontal and ascending portions of the "U." The tricuspid valve area is represented by a constriction between the auricle and ventricle, giving the right heart a butterfly appearance. A second constriction may be present where the outflow tract of the right ventricle continues as the pulmonary aorta. This represents the site of the (ventricular) conus arteriosus and is situated deep within the cardiac silhouette. At times the location of the cusps of the pulmonary valves may be recognizable. In this position the pulmonary aorta is border-forming. The right pulmonary artery is foreshortened, and the left is visualized in its length crossing the clear space and subdividing in the left lung. The right ventricle is lo-

cated in the posterior half of the cardiac silhouette and is not a border-forming structure anteriorly.

The left auricle and the left ventricle form a figure-of-eight, lying in an almost horizontal plane, with the auricular shadow at a slightly higher level and posterior to the ventricular shadow. The auricle does not form any part of the cardiac border in this position. A constriction between the auricular and ventricular shadows represents the annulus or the mitral valve area. The left ventricle occupies the greater part of the cardiac silhouette and is border-forming anteriorly (Fig. 7).

Left Anterior Oblique Position: The two arms of the "U"-shaped structure of the right heart, shown in the postero-anterior and right anterior oblique positions, are superimposed in the left anterior oblique view (Fig. 8) and form an elongated rectangular structure with a slight anterior convexity in its long axis. The right auricle and right ventricle cannot be identified as separate chambers. The interventricular septum, or posterior boundary of the right ventricle, is convex to the right. The superior vena cava enters posteriorly. The left pulmonary artery is foreshortened and the right is visualized in its full length. The auricle rests on the diaphragm. The ventricular conus is visualized, as are the pulmonary aorta, its bifurcation, and the right and left pulmonary arteries.

The left heart appears as a kidney-shaped structure with its hilum directed upward and anteriorly (Fig. 9). The upper and smaller part is the left auricle. The lower and larger part is the left ventricle. A constriction separating the upper from the lower part represents the site of the mitral valve or annulus. The pulmonary veins enter the auricle posteriorly. The aorta arises from the upper and anterior portion of the ventricular shadow, describes an arc in the thorax, and descends along the vertebral column.

Lateral Position: In this projection the contours of the right and left portions of the heart are similar to those observed in the left anterior oblique position.

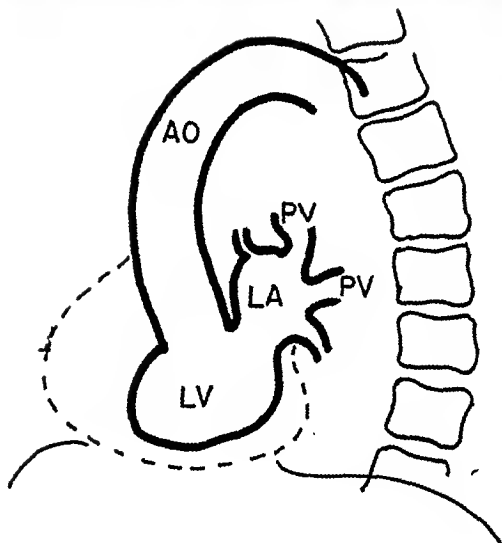
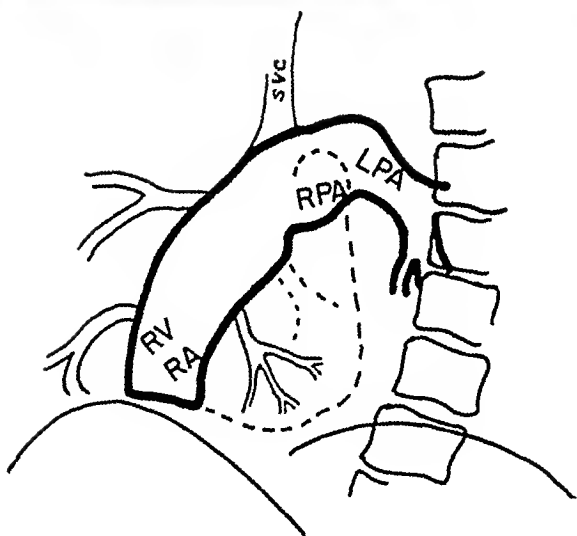


Fig. 8. Left anterior oblique view, showing elongated rectangular right heart.

Fig. 9. Left anterior oblique view of left heart: a kidney-bean-shaped structure.

PATHOLOGIC ANATOMY

Cardiac enlargement may be due to hypertrophy, chamber enlargement, or both. In the postero-anterior projection, chamber enlargement of the right heart presents a "U"-shaped structure similar to that seen in the normal heart, but wider (Fig. 10). It is dilated and occupies a larger area but does not occupy the entire

frontal plane of the cardiac silhouette. The interventricular septum is shifted to the left. The left ventricle occupies a good portion of the cardiac silhouette. The middle segment of the left heart is accentuated and appears either flattened or convex.

In the left anterior oblique position the enlarged right heart presents a shape quite different from that normally observed. It may be globular, it may resemble an in-



Fig. 10. Postero-anterior view, showing enlarged right heart, right innominate vein, superior vena cava, right auricle, tricuspid area, right ventricle, pulmonary aorta, right pulmonary artery. The aortic knob is seen with calcific plaque.

verted mushroom (Fig. 11) with the greatest enlargement inferiorly, or it may present a tongue-like appearance with the greatest enlargement superiorly (Fig. 12). At times the interventricular septum is convex to the left; more often, however, it is convex to the right. The auricular and ventricular shadows merge, the ventricular conus being located above and anteriorly, continuing as the pulmonary aorta, which is prominent, and divides into the pulmonary arteries (Fig. 13).

The left heart chamber enlargement is demonstrable in all projections. In the postero-anterior view one or both of the component parts of the figure-of-eight, are enlarged. Auricular enlargement tends to be spherical, moving to the right; the enlarged auricle is not a border-forming structure of the left side. Ventricular enlargement is oval and moves to the left and downward.

In the left anterior oblique projection left ventricular chamber enlargement shows an encroachment on the right heart area. The left ventricular shadow becomes oval



Fig. 11. Left anterior oblique view: mushroom-shaped right heart.



Fig. 12. Left anterior oblique view: tongue-like large right heart.

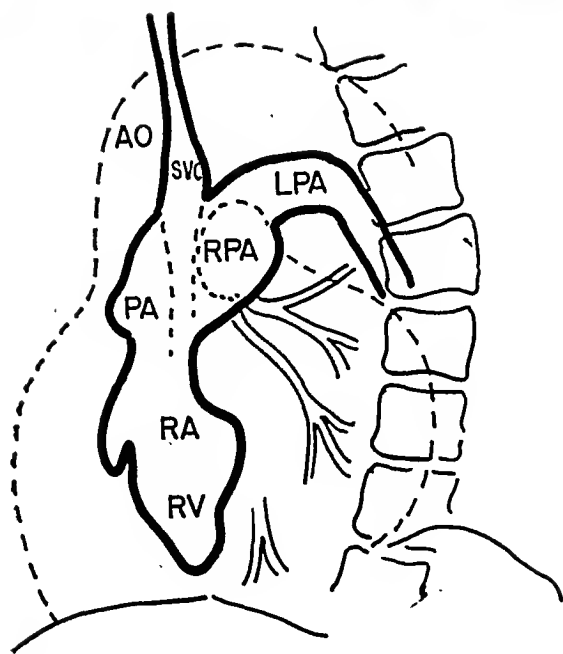


Fig. 13. Left anterior oblique view: large right heart.

and advances anteriorly and posteriorly. The interventricular septum is curved anteriorly and is situated more anteriorly. In a few instances the left heart enlargement presented a tongue-like appearance (Fig. 14), with the greatest enlargement



Fig. 14. Left anterior oblique view of enlarged left heart, showing tongue-like shadow with no differentiation between aorta and left ventricle.

above, not unlike that found in right heart enlargement.

The above statements are based upon observations made in 120 persons. Eighteen of these were normal; the remainder of the group had various cardiovascular disorders.

SUMMARY

The normal appearance of the heart chambers and the large vessels is described, as are the changes observed in size and shape in cardiac patients with and without hypertrophy.

This type of study permits of a differentiation of vascular from non-vascular mediastinal lesions. It is of value in congenital cardiac and vascular anomalies.

The cardiac anatomy as demonstrated roentgenographically is not entirely in accord with descriptions found in textbooks. We observed that the middle cardiac segment is formed most often by the left pulmonary artery, infrequently by the pulmonary aorta, and sometimes by both. The descending aorta may participate. The conus (ventricular) is deeply situated; it is

never a border-forming structure and is quite removed from the (concave) middle cardiac segment.

In the postero-anterior projection the right heart does not occupy the major portion of the cardiac silhouette. In the right anterior oblique projection, the left heart occupies a considerable portion of the cardiac silhouette anteriorly.

Two non-opacified areas were found in the cardiac silhouette. One, at the lower portion of the right cardiac silhouette, is thought to be the inferior vena cava. The other, at the junction of the middle cardiac segment and base of the left ventricle, is believed to be a solid portion of the left auricular appendage.

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Erythroblastic Anemia

With Report of a Case in a Boy Eight Years Old¹

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ERYTHROBLASTIC anemia, Mediterranean anemia, thalassemia, or Cooley's anemia was separated by Cooley in 1927 from the group of anemias showing the von Jaksch syndrome, on the basis of its racial incidence. The disease is familial, occurring only in children of the races derived from the Mediterranean region, especially Greece and Italy. It is characterized by a slowly progressing anemia and by the presence of a large number of nucleated red cells.

The extraordinary proliferation of erythroblastic tissue leads to changes in the bones, especially in the skull. Extreme pallor of the skin with an icteric tint may be the first sign, then a prominent abdomen from splenomegaly. These signs and symptoms may increase, and evidences of cardiac insufficiency may become manifest. Periods of unexplained fever may occur. Physical development may be retarded. A mongoloid appearance is the next condition that goes to make up the picture. There may be epicanthus and mild exophthalmos.

The skull shows prominent frontal and parietal bosses; by contrast the sutures may appear depressed. The liver and lymph nodes are generally enlarged, great enlargement of the spleen is constant, frequently the heart is hypertrophied, and there may be a systolic murmur. In severe cases of long standing, myocardial damage may be demonstrated.

Roentgen examination of the skeleton shows osteoporosis of the long bones with trabeculae standing out clearly. The cortex is thin. The medullary cavity is widened and transverse lines are conspicuous. In the skull the space between

the tables is widened, and the outer table is reduced to such thinness as not to be visible on the roentgenogram. The trabeculae connecting the inner and outer tables give the appearance of "hair standing on end."

Blood studies usually show a low color index, marked anisocytosis and poikilocytosis, immaturity of red cells, increase in platelets and a polymorphonuclear leukocytosis with numerous immature cells. Reticulocytes are somewhat increased, constituting 5 to 20 per cent of the red cells. Fragility tests have shown a prolongation of the span of hemolysis, beginning at 0.50 to 0.54 per cent, complete at 0.30 to 0.20. According to Cooley and Lee, the red cells have certain specific characteristics. They tend to be large and to have an uneven distribution of hemoglobin. An abnormality of the stroma has also been described, which, however, may also be encountered in sickle-cell anemia. Increased blood destruction occurs but is not so marked as in sickle-cell anemia. The bilirubin content of the blood is increased, the Van den Bergh reaction is indirect.

Whether a "latent" form of erythroblastic anemia exists remains a question. The course of the disease is progressive, but some patients may survive into adult life. At times there are periods of hyperpyrexia, without other evidence of infection. Death, however, is usually due to infection.

In the opinion of some writers transfusion is a reliable therapeutic measure. Splenectomy causes an extraordinarily prolonged erythroblastic crisis, the nucleated red cells remaining high for months or even years. Very little is accomplished generally by this means. All therapeutic measures used so far have in the end been futile.

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

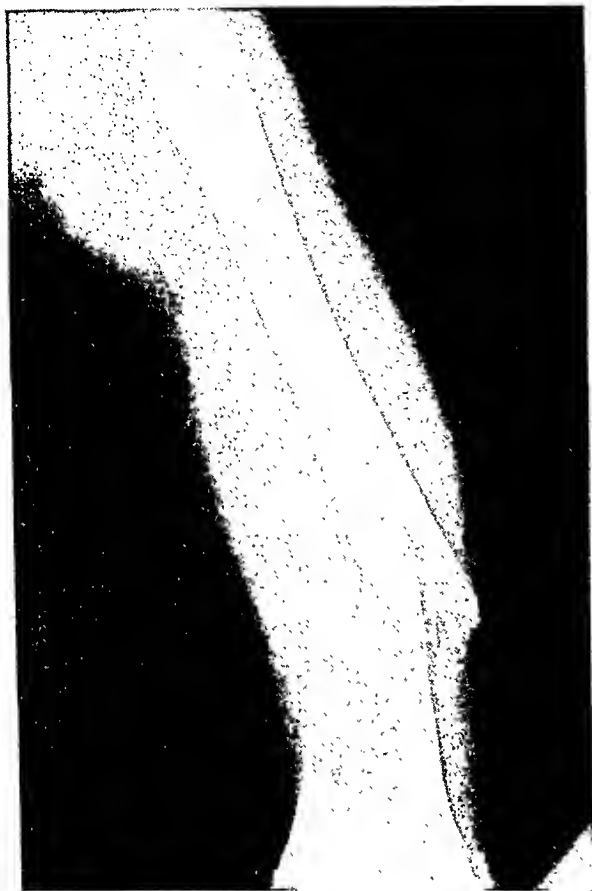


Fig. 1. Pathological fracture of lower third of the left femur.

Caffey (1) gives a very full presentation of the subject, recording his studies in 21 cases of erythroblastic anemia, 15 cases of sickle-cell anemia, and 6 cases of chronic hemolytic anemia. He found that there were no significant changes in the long bones in the cases of sickle-cell anemia, nor were vertical striations of the skull found in any case. In the 6 cases of hemolytic icterus no significant changes were found in the long bones, though 2 patients showed striations of the calvarium similar to those seen in erythroblastic anemia. In each instance the parietal bones were more involved than the frontal.

Borzell (2) reported 3 cases of erythroblastic anemia in 1933, 2 of his own and 1 of Dr. Ralph S. Bromer. Borzell states that one of the patients under his care improved following therapeutic application of roentgen rays; the spleen was reduced to normal size, the weight increased, and the appetite improved. Not only did the

bone changes fail to progress but there was some improvement.

Baty, Blackfan, and Diamond (3) published a series of 20 cases in 1932 and presented a review of 26 cases reported by other authors.

Feingold and Case (4) reported a case

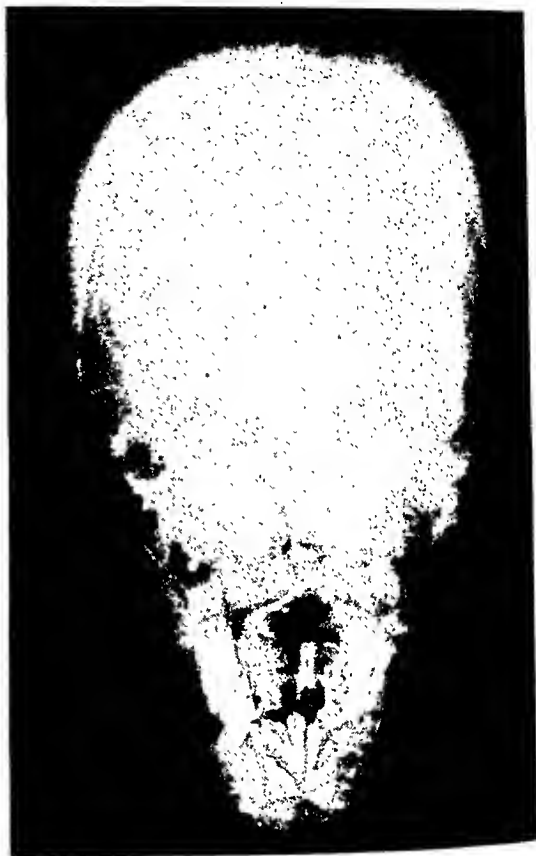


Fig. 2. Skull roentgenogram showing vertical striations, giving the appearance of hair standing on end.

with skull findings characteristic of erythroblastic anemia and gave some interesting points on other anemias of children and on comparable findings in the skulls of Peruvian Indians. Whipple and Bradford (5) reported 3 cases and criticized the terminology as unsatisfactory, suggesting the term Mediterranean anemia or thalassemia.

Cooley and Lee (6), writing five years after Cooley's first paper, state that their further experience with erythroblastic anemia has strengthened their conviction that it is a clinical entity. All the cases originally reported by Cooley (7) occurred in Italians or Greeks.



Fig. 3. Roentgenogram showing prominence of bones of face and upper jaw.

CASE REPORT

F. C., a boy aged eight, of Italian parentage, was admitted to St. Joseph Hospital, Carbondale, Penna., on April 15, 1943, for an x-ray examination of the left femur. This disclosed a complete fracture of the lower third of the bone (Fig. 1). Since it was clearly evident that the bone was diseased at the site of fracture, further examinations of the skeleton were made. Changes characteristic of erythroblastic anemia were found in the skull (Figs. 2 and 3). Vertical striations are plainly demonstrated, as are thinning of the outer table and marked enlargement and osteoporosis of the bones of the upper jaw and face, in Figures 2 and 3. Changes were also present in the spine and ribs. The ribs showed widening of the medullary canal and thinning of the cortex.

The patient appeared poorly nourished. The spleen was more than moderately enlarged. The liver was not enlarged and there were no heart murmurs.

The blood count was: red cells 2,750,000; white cells 12,000; hemoglobin 44 per cent. There were 10 to 15 nucleated red cells to the oil immersion field.

The patient left the hospital after the fracture healed. Later we were informed that he was taken to another institution, where a splenectomy was

done. He was alive at this writing, Jan. 3, 1944, but in poor condition.

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A Simple Fluoroscopic Method of Foreign Body Localization¹

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THE FUNDAMENTAL principles of different methods of foreign body localization were nearly all set forth within a few years after the original discovery of x-rays. The extensive literature on the subject since then has dealt chiefly with modifications or refinements of technic to overcome some shortcoming or to fill some special need. (For a summary and bibliography see the appended references.)

Practically all of the fluoroscopic methods either have been developed for the purpose of facilitating work in a military hospital or require special apparatus or attachments, or some preliminary calibration. There is need for a simple method which can be used in civilian laboratories employing only the materials generally at hand and without any special arrangements or preparatory adjustments or settings of the apparatus. The method to be described here requires only a standard table fluoroscope and the ordinary parallel arm caliper used in most laboratories to measure patient thickness.

The method is a refinement of the parallel principle first described by Levy-Dorn in 1897 and elaborated during the last war by Jordan, Young, and Blaine, among others. It consists essentially of locating, with the movable blade of the caliper, a point alongside the patient which is in the same horizontal plane as the foreign body, and is based upon the fact that shadows of objects in the same plane are displaced to an equal extent when the fluoroscope is moved.

Since the movable arm of the common caliper is a blade an inch wide, some point on it must be defined which can be readily recognized on the fluoroscope. This is easily done by taping on the blade a small bit of wire, such as a bent paper clip, so that a point projects a fraction of an inch

beyond the end of the bottom edge of the blade. It is the tip of this wire that is to be positioned in the same plane as the object to be localized.

The localization is performed in two steps: (1) Position the tip on the caliper in the same transverse plane (perpendicular to the table top) as the object. (2) Raise the caliper arm until it is in the correct horizontal plane (parallel to the table top), as shown by equal shift of the tip and object when the fluoroscope is moved. To do this, stand the caliper on the table along side the patient, with the blade beneath the screen so that the tip can be seen when the fluoroscope is turned on. Because of limitations of space beside the patient on the table top, the caliper may have to be placed parallel to the patient, only the tip being used as a reference point, not the whole arm as a pointer. Move the caliper along beside the patient until the tip is in the same transverse plane as the foreign body; this can best be done by closing the shutters to a narrow transverse slit with the shadows of the object and tip just barely seen simultaneously (Fig. 1). Then open the shutters about two-thirds and move the fluoroscope until the shadow of one of the shutter edges just touches the shadow of the object. While holding the caliper standing where it was set in the first step, raise the movable arm until the shadow of the tip just touches the same shutter edge. The tip is then in the same horizontal plane as the object. The caliper can easily be read in the fluoroscopic-room light, and the dimension indicated is the distance of the object above the table top. The distance from the table to the top surface of the patient can be measured directly with the caliper, and the difference is the depth sought.

Necessary precautions are few and simple. The slit for transverse alignment should be as narrow as possible; final posi-

¹ Accepted for publication in March 1944.

tioning should be done with a slit so narrow that a slight change in the shutter closes off the x-ray beam entirely. The caliper must be firmly held in position while the shutter is opened, the fluoroscope moved for the second alignment, and the arm raised to final position. In making the final alignment, it is better to shift the fluoroscope in such a direction that the shutter edge toward the anode end of the tube is used, since in that way the focal spot is foreshortened and the shadow of the shutter is sharp, whereas if the edge toward the filament end is used the shadow is blurred and the accuracy of results impaired. An accuracy of 1 cm. in localizing the depth is easily achieved, and with reasonable care better than 0.5 cm. is not incompatible with speed.

This parallax method is not only rapid and sufficiently accurate for localizing gross fragments, but it uses only what is commonly available and is quite free of hazards making for inaccuracy or inconvenience. No special devices or attachments or cones are needed, and no locks or fixed shift for the screen. No mathematical computations, tables, or charts are used. No drawings are made. The distance between tube and screen or screen and table need not be known, nor the distance between the screen and patient, which is required with many methods and yet is not easy to get without some special arrangement. Since no measurement of shadow shift is involved, the screen need not be held at a fixed distance from the focal spot but may be lifted to any convenient position above the patient. It is not necessary to keep the screen parallel to the table, but it may tip or tilt in any direction without affecting the results. Finally, the method may be used equally well with a unit where the screen and tube move independently or with one in which they are attached and move together.

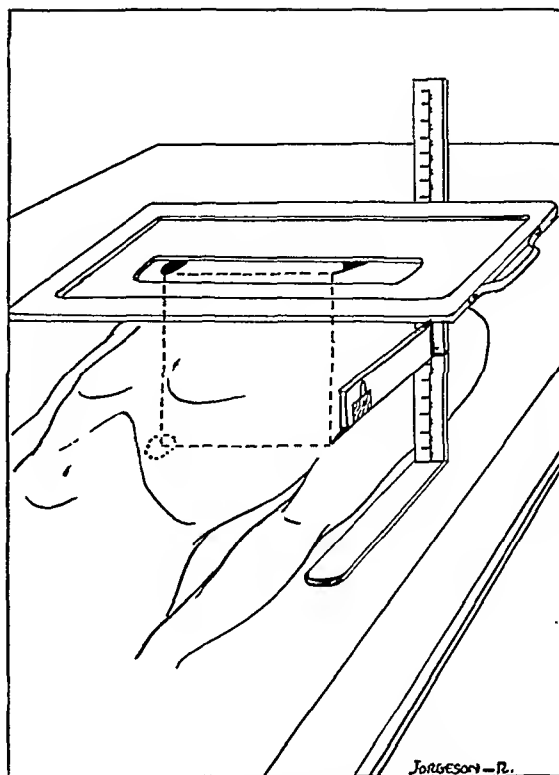


Fig. 1. The caliper stands on the table alongside the patient and is moved about until the tip on the blade is in the same transverse plane as the foreign body.

Caution: With equipment where tube and screen move independently, be sure the x-ray beam is always *entirely* on the screen, as otherwise the observer is subjected to excessive irradiation. If mobile or portable equipment is used, the patient's nearest skin surface should be at least 10 to 12 inches from the target of the tube, else the patient will be excessively irradiated. As with all fluoroscopic procedures, one must be sure the established safe exposure time for the patient is not exceeded.

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Clinico-Pathological Conference

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Lahey Clinic

and

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New England Deaconess Hospital

A salesman, aged 33 years, was admitted to the Clinic on Sept. 7, 1943, because of a tumor of the right thigh of two years' duration, with some resultant disability involving the right thigh and slight discomfort at times but no severe pain. He noticed a gradual increase in the size of the tumor one year before entry. There had been a loss of 12 pounds in weight but this had been regained. The patient had been given Coley's fluid elsewhere in July 1943. He also received 1,000 roentgens of radiation therapy elsewhere, in divided doses. No other therapy was given.

Physical examination revealed a well developed, stocky adult in good general health. In the right inner upper thigh was a large mass, about 12 cm. in diameter, attached to the deep structures of the pelvic arch but not to the femur. Over this area the skin showed some brown pigmentation but it was not fixed to the mass. There was increased local temperature. There was no marked enlargement of the inguinal nodes, and no limitation of hip motion except adduction when the tumor impinged on the perineum.

G. E. Haggart, Sept. 7, 1943: Diagnosis: Sarcoma of the inner proximal right thigh—type to be determined.

The mass is about the size of two large fists, dome-shaped, located in the proximal medial thigh compartment in the adductor area and extending from the midperineal area anteriorly to the midanterior line of the thigh and about the same distance posteriorly and distally. An attempt should be made at excision, with the distinct understanding on the part of the patient that it may not be successful so far as recurrence is concerned. I told him quite frankly that I thought he had a sarcoma—



Fig. 1. Roentgenogram showing tumor of right thigh (Aug. 3, 1943).

which I defined as a malignant lesion—that the prognosis was distinctly uncertain, but that I believed if he continued without treatment an ulcer would eventually develop as a result of circulatory failure in the tumor, in which event he would be in a very difficult and extremely unpleasant situation.

The patient is to have roentgenograms of the lungs, which I would expect to be negative in view of the long duration of the

mass and the fact that it has not increased greatly in size. He has no pain. He is to return home and talk to his physician and family and let us know what he will do. The possibility of radiation treatment depends on the results of histologic examination of the tumor.

[On the advice of his local physician (Sept. 12, 1943), the patient decided he would not be operated upon. He received no further treatment at this time. In February 1944 he wrote stating that he was disabled because of increasing pain, and asked to be admitted to the hospital



Fig. 2. Roentgenogram showing increase in size of tumor (March 30, 1944).

Hugh F. Hare, Sept. 8, 1943: Roentgenograms of the right femur and hip taken elsewhere (Barre City Hospital, Barre, Vermont) April 20, 1943, and a second roentgenogram taken August 3, 1943 (Fig. 1), show a large soft-tissue mass in the medial aspect of the right thigh proximally. Apparently the mass is connected with a lesion involving the descending ramus of the ischium, which shows a heaping up of new bone around it, probably a pathological fracture. There has been some increase in the amount of calcific material since April, and there has been a definite increase in the size of the mass. Probably the tumor is an osteochondrosarcoma. Chest roentgenograms should be taken.

for whatever treatment we thought advisable. He therefore went into the New England Deaconess Hospital on March 28, 1944.]

G. E. Haggart, March 30, 1944: This man returns because severe pain has developed in the upper inner left thigh. He has been unable to work the past two months and is now willing to submit to any type of treatment.

Examination shows an appreciable increase in the size of the mass in comparison to its size when I last saw him. It is very hard and fixed to the inferior pubic ramus. Furthermore, the mass extends posteriorly into the lower inner buttock, bulges medially against the rectum, and

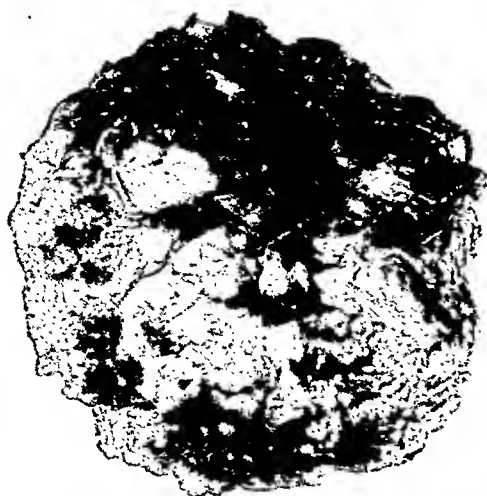


Fig. 3. Tumor removed.

extends anteriorly to the anteromedial border of the thigh. Distally, from the pubic bone, the mass is about 18 cm. in length down the thigh. Roughly spherical, it measures approximately 14 cm. in diameter. Doctor Lahey notes that on examination the mass is found to extend well up within the pelvis.

The roentgenograms taken on admission (Fig. 2) show changes which I think are most compatible with a chondrosarcoma. Roentgenograms of the lungs are negative for metastases. In view of these findings, palliative surgery is considered unwise. Chordotomy is to be considered.

Diagnosis: Chondrosarcoma, slowly growing but definitely malignant, of the upper inner right thigh and adjacent pubic and ischial rami.

J. H. Marks, March 29, 1944: A roentgenogram of the chest shows the lungs to be clear. Cardiac and diaphragmatic shadows appear to be normal. Roentgenograms of the pelvis and right thigh show a soft-tissue mass which apparently arises near the junction of the right pubis and ischium. This mass measures about 14 X 17 cm. It extends both anteriorly and posteriorly, and its posterior portion extends upward so that it displaces the lower rectum to the left of the midline. Its upper limit is at the level of the ischial

spine. The major portion of the tumor is of homogeneous density, but there is an irregular mass of bone near its point of attachment to the pelvis. This bony mass measures only about 5 cm. in diameter.

Impression: The findings are probably those of an osteochondroma; the large proportion of cartilage suggests that it is probably malignant.

G. E. Haggart, March 31, 1944: Doctor Poppen has seen the patient and agrees that a chordotomy can be considered if we decide that excision of the mass should not be attempted.

[At a meeting of the Tumor Clinic, it was decided to attempt radical removal, for the following reasons:

1. Ulceration of the thigh over the mass was certain to occur in the near future.

2. In view of the pressure on the rectum from the growth of the tumor, obstipation was certain, requiring cecostomy.

3. The mass roentgenographically appeared encapsulated and, even though malignant, might possibly be removed *in toto*.

Against radical surgery, the following points were considered:

1. The tumor was large and, if it were removed, the remaining blood supply might not be adequate for healing of the wound.

2. The location of the tumor, with its proximity to the rectum and major vessels, made the surgical approach extremely hazardous.

Ligation of the internal iliac artery, as suggested by Doctor Lahey, before attempting radical removal was deemed necessary to prevent hemorrhage at operation.]

G. E. Haggart, April 10, 1944: Operation was done in two stages, the first, ligation of the right hypogastric artery, by Doctor Cattell. Through a right rectus incision, the peritoneum was opened, the bowel retracted and the bifurcation of the abdominal aorta exposed with particular reference to the right external and internal iliac artery. The ureter was clearly visualized and preserved. A heavy silk ligature was passed around the hypogastric

(internal iliac) artery and tied tightly. The wound in the peritoneum was closed, as was the abdominal wound, by the usual technic.

Anesthesia: Pontocaine, spinal fractional; ether, semiclosed; cyclopropane, carbon dioxide absorption; pentothal, intravenous; cocaine, topical.

The patient was then placed on his left side, at which time the blood pressure dropped sharply, but this was controlled

far as the shaft of the femur. There was a lateral prolongation of the tumor on the external aspect of the bony pelvis covering the obturator foramen, extending medially as far as the symphysis.

The tumor was covered by a heavy, dense capsule except for that part within the pelvis which, while invading the adjacent musculature, consisted of a series of lobules with a thin, fibrous envelope. The tumor arose from a single stalk at the



Fig. 4. Roentgenogram taken after operation.

satisfactorily by the anesthetist. An incision was made in the distal medial portion of the right buttock directly over the ischiorectal fossa and extended down, slightly laterally, over the proximal inner thigh. Following division of the subcutaneous fat, the ischiorectal fossa was exposed. The tumor protruded well up into and, in fact, practically filled, the fossa, and was pressing directly against the rectum. From this area, the mass extended down into the proximal posterior medial and anteromedial thigh and laterally as

junction of the pubic and ischial rami and lay beneath the medial hamstring muscle group, extending laterally, medially, and anteriorly in this same plane. The quadratus femoris muscle was spread out over its surface and had to be entirely sacrificed.

The hamstring muscles were detached from the ischial tuberosity and adjacent ischium and pubis. The site of origin of the mass as described was then removed *en bloc*. By blunt dissection, the tumor within the ischiorectal fossa was delivered and removed. Following this, the skin,

subcutaneous, and muscle incisions were extended somewhat medially and, by further blunt dissection, the entire mass was delivered from the proximal and anterolateral portion of the thigh. Considerable difficulty was encountered in dissecting the capsule of the tumor from the lateral aspect of the ascending pubic ramus and symphysis, to which it was firmly adherent.

The part of the tumor in the thigh was removed as one specimen. The sacrotuberous ligament was preserved and the sciatic nerve identified and protected from injury. It was necessary to divide numerous branches of the pudendal nerves and to clamp, tie, or coagulate the many hemorrhoidal and pudendal veins. Hemostasis was obtained, and two Penrose tube drains were inserted, one in the ischio-rectal fossa, the other in the large space the tumor had occupied over the lateral aspect of the pubic and ischial rami, and brought out through a separate stab incision. The hamstring muscles were reattached to the ischio-rectal tuberosity, ischial and pubic rami, and the remaining superficial tissues were closed with interrupted sutures.

During operation, the patient received a transfusion of 500 c.c. of blood. His general condition throughout the procedure was good.

The impression obtained from visualization and removal of this large mass, which measured about 25×15 cm., was that it was a benign lesion.

Diagnosis: Osteochondroma, very large, question of malignancy, arising from the junction of the right ischial and pubic rami, filling the ischio-rectal fossa and extending down into the posterolateral, medial, and anteromedial thigh.

Postoperative Course: Convalescence was uneventful; the wound healed by first intention.

Clinical Diagnosis: Osteochondrosarcoma.

Roentgen Diagnosis: Osteochondrosarcoma.

Operative Diagnosis: Osteochondroma.

Microscopic Diagnosis: Osteochondrosarcoma.

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CASE REPORTS

Cardiospasm¹

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and

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Cardiospasm usually presents a clinical picture characterized by epigastric pain or discomfort, dysphagia, and regurgitation of food. No difficulty is encountered, as a rule, in establishing the clinical diagnosis and the roentgenographic confirmation. Cases have been reported, however, in which the symptoms were obscure or the real diagnosis was masked by pulmonary complications.

In a case of cardiospasm recently seen by us there were no noticeable symptoms; pulmonary complications were present, and a mediastinal mass was found which was not explained until fluoroscopic examination was made of the esophagus, with barium.

Shelburne (6) reported a case of cardiospasm in which the dilated esophagus was thought to represent a mediastinal abscess. There was only a slight degree of dysphagia, which contributed to the error in diagnosis. Mitchell (4) cited several cases from the literature in which the dilated esophagus was mistaken for a mediastinal tumor. One of these cases was subjected to roentgen therapy to the mediastinum on the basis of the mistaken diagnosis. Mitchell also quoted a case, reported by Schmidt, in a six-year-old girl with a diagnosis of aspirational pneumonitis, which could not be controlled until dilatation of the esophagus had been carried out. Another case was reported in which for ten years the diagnosis had been pleuritis mediastinalis, because the condition was associated with periodic attacks of fever and pulmonary symptoms. Sampson (5) reported one case in which the presenting symptoms were referable to a lung



Fig. 1. Roentgenogram showing aspirational pneumonitis due to esophageal overflow in the right lower lobe, limited by the interlobar septum above. The right diaphragm is elevated, indicating atelectasis. The mediastinal mass representing the dilated esophagus, extending to the right, can be seen.

abscess due to esophageal overflow, associated with the cardiospasm.

CASE REPORT

A 26-year-old colored male was admitted to the Fort Bliss Station Hospital on Aug. 31, 1942, with a diagnosis of acute gonorrhea of two weeks' duration. He had also an acute upper respiratory infection of four days' duration.

Except for slight injection of the nasopharynx and the urethral discharge there were no abnormal findings on physical examination. The admission temperature was 100° F., the pulse rate was 78, and the respiration was 18 per minute. The Kahn test was negative. Blood studies revealed no anemia. The urine contained pus and gram-negative diplococci.

The gonorrheal infection was controlled with oral chemotherapy and the temperature returned to normal within twenty-four hours and remained normal throughout the patient's stay in the hospital.

¹ From the Roentgenological Service, Station Hospital, Fort Bliss, Texas. Accepted for publication in January 1944.



Fig. 2. Roentgenogram showing the barium-filled dilated, tortuous esophagus. The constriction of the cardiac portion is clearly seen.



Fig. 3. Roentgenogram taken after amyl nitrite inhalation, showing barium in the dilated stomach, with some remaining in the esophagus.

On account of the respiratory infection, the possibility of pneumonia was considered and x-ray examination requested. A roentgenogram of the chest, Sept. 3, showed changes in the right lower lung field, considered to be pneumonia, and a mediastinal mass extending toward the right, which was not explained.

The patient made an uneventful recovery and further roentgenographic studies were made. Fluoroscopic examination with barium showed the dilated esophagus, with obstruction at the cardia, thus establishing the diagnosis of cardiospasm (Fig. 2). With the dilated esophagus filled with the barium solution, the patient was given an inhalation of amyl nitrite. Fluoroscopically, a partial relaxation of the cardia was observed and some of the solution passed into the stomach; a large amount of barium, however, remained in the esophagus (Fig. 3).

At a later date a routine check-up chest examination was made and a small patch of unsuspected aspiration pneumonitis was observed in the lower lung field. The patient presented no symptoms at this time that would lead one to suspect the disease in the left lung.

On careful questioning, the patient admitted that

for five or six months he had experienced a discomfort or a sense of fullness on drinking or eating, for which he had consulted physicians on two different occasions. He had discovered that after eating a full meal the discomfort could be relieved by voluntary vomiting and at times he had raised blood with the vomitus. He had lost about fifty pounds in weight during the past year. He denied any undue coughing and there had been no strangling spells.

DISCUSSION

Roentgenologically, the typical case of cardiospasm offers no diagnostic difficulties when properly examined. On the roentgenogram, without barium in the esophagus, there is usually seen in the advanced case a wide supracardiac shadow, projecting to the right and suggesting a mediastinal mass or cardiac enlargement (Fig. 1). Fluoroscopic examination with barium suspension in the esophagus is, of course, essential. The case recorded here again

illustrates the importance of studying the barium-filled esophagus in the presence of obscure changes in the mediastinum and the medial portion of the lungs. Fluoroscopy and a roentgenogram with barium in the esophagus revealed the dilated esophagus filled with fluid and food particles. At the esophageal orifice there was a constriction with only a trickle of barium passing into the stomach. With the inhalation of amyl nitrite, the cardia relaxed and a portion of the esophageal contents passed into the stomach. The degree of relaxation and the amount of esophageal contents passing into the stomach will vary with the stage of the disease. This is an important procedure in the differential diagnosis of cardiospasm and carcinoma, since in the latter, because of the infiltration, there will be no relaxation of the cardia. Kornblum and Fisher's (3) report of 3 cases of dilated esophagus with carcinoma emphasizes the importance of a careful study and, also, some of the difficulties encountered in a differential diagnosis, particularly in the older age group.

SUMMARY

A case of cardiospasm is presented with several features of interest:

1. Symptoms were not sufficiently appreciated by the patient to cause him to impress upon the physicians who previously-examined him the necessity for x-ray examination.

2. There developed an aspiration pneumonia, undoubtedly due to an esophageal overflow and aspiration of some of the esophageal fluid. Thus, the pulmonary complication prompted further investigation and the roentgenographic studies disclosed the condition.

3. The true nature of the mediastinal mass was not determined until the esophagus was studied fluoroscopically with a barium mixture.

4. The importance of fluoroscopic studies of chest conditions, particularly with barium paste in the esophagus, is again emphasized.

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Aberrant Pancreatic Tumor in the Duodenal Wall¹

SAMUEL BROWN, M.D., KAMILLO FLACHS, M.D.,
and PHILIP WASSERMAN, M.D.

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According to Ewing, the duodenum is the common site for aberrant pancreatic tissue, which infrequently gives rise to a new growth. Such a case has recently come under our observation. Because of the rarity of the lesion and the interesting x-ray findings, we believe that it merits a detailed report.

Mrs. I. S., age 64, was admitted to the Jewish Hospital on Dec. 10, 1942, because of pain in the abdomen, loss of appetite, "sour stomach," and frequent vomiting during the preceding two months. The physical examination revealed no palpable masses in the abdomen. There was some tenderness in the region of the epigastrium upon deep pressure. Clinical laboratory studies showed nothing remarkable.

A complete x-ray study of the gastro-intestinal tract was carried out. A plain view of the abdomen showed no dense shadows in the region of the gallbladder suggestive of stones. After the oral administration of tetraiodophenolphthalein sodium dye the gallbladder failed to fill. A barium-meal study showed the stomach to be of normal size and shape without filling defects. The bulb was of normal size and shape, containing both barium and gas

¹From the Departments of Roentgenology and Pathology, the Jewish Hospital, Cincinnati, Ohio. Accepted for publication in November 1943.

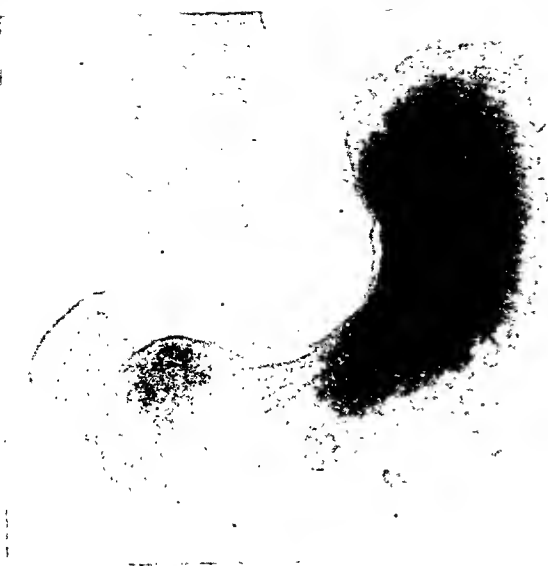


Fig. 1. Aberrant pancreatic tumor in the duodenal wall. Barium study, showing normal appearing stomach and bulb of normal size and shape.

(Fig. 1). In the right lateral position the stomach and duodenum were found to be in normal relation to the surrounding structures, with the duodenal loop outlined through its entire course; the unusual feature was that the latter contained gas with only a little of the barium mixture irregularly distributed in its lumen (Fig. 2). On the following day only a small amount of barium was observed in the colon, the rest having been vomited shortly after examination. A barium enema revealed no obstruction or deformity in the entire course of the colon. The diagnosis was a probable gallbladder lesion.

Ten days later re-examination of the gallbladder following intravenous injection of tetraiodophenolphthalein revealed a uniform filling of only moderate density. In the right lumbar region was a large oval pocket containing gas, apparently in the duodenum, a rather unusual finding in the absence of gas in the stomach (Fig. 3). A second barium-meal examination again revealed a stomach of normal size with a markedly dilated duodenum ending abruptly at the inferior angle (Fig. 4). In the right lateral position the ascending portion of the duodenum presented a contour deformity encroaching upon its lumen, apparently causing stenosis (Fig. 5). Since the deformity appeared to be within the duodenum, an extrinsic lesion was excluded and the diagnosis of a new growth originating in the duodenum was made.

The patient was operated upon and a tumor, which was readily located in the ascending portion of the duodenum, was resected. When the resected segment was examined a true stenosis of considerable degree was found, apparently due to an obvious palpable mass involving the wall. The mucosa was essentially normal. Its only abnormality was a

minute area of reddish flecking that extended toward the tumefaction in the wall.

Microscopic studies of the mass in the duodenal wall showed a new growth arising from pancreatic tissue. Since the pancreatic tissue of the head, which was attached to the ascending loop of the duodenum, was free of tumor formation, it was concluded that the new growth originated from aberrant pancreatic tissue in the duodenal wall. Furthermore, the character of the tumor strongly suggested that the aberrant tissue was ductal in origin.

CONCLUSION

A case of a tumor in the duodenal wall arising from an aberrant pancreas is reported. X-ray examination made possible localization of the new growth in the ascending portion of the duodenum.

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Direct Current Combined with X-Ray Therapy: Case of Kaposi Sarcoma Thus Treated¹

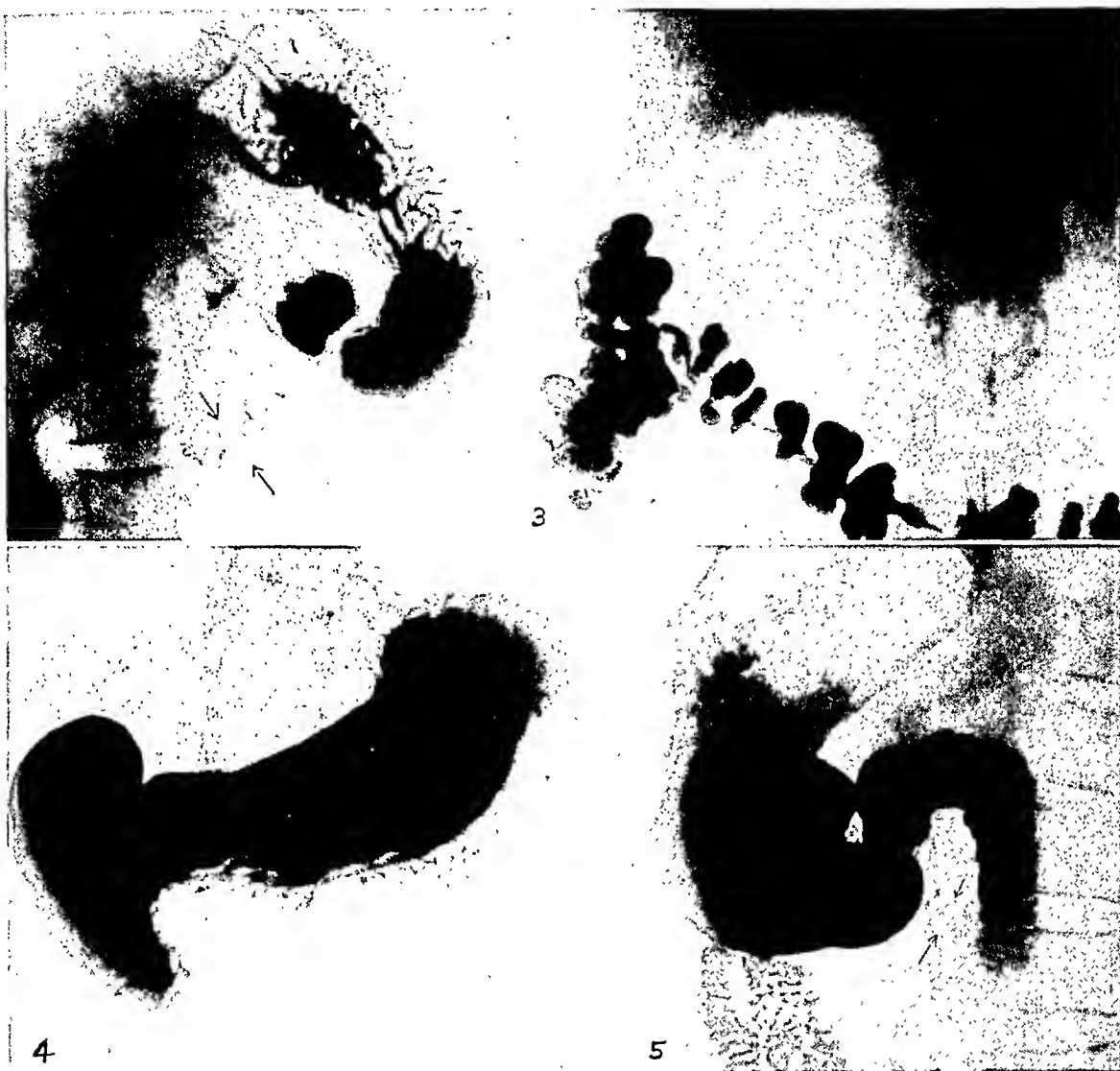
HARRY SIGEL, M.D.

Cincinnati, Ohio

The use of direct current in combination with x-ray therapy in order to increase the efficacy of the latter has not been reported, although it has been known for some time. Our basis for this procedure is of necessity, therefore, purely theoretical.

In the case to be reported treatment was given with the following x-ray therapy factors: 120 kv.p., 5 ma. filament current, 4 mm. Al filtration, 25 cm. distance. The output of the apparatus was 15 r per minute. Each area received a total of 1,500 r. The electrical apparatus consisted of an ordinary galvanic machine and a pair of electrodes made of felt pads soaked in normal saline. The positive electrode was placed over the tumor area and the negative electrode over a nearby area, so that

¹ From the Department of Dermatology of the College of Medicine of the University of Cincinnati. Accepted for publication in December 1943.



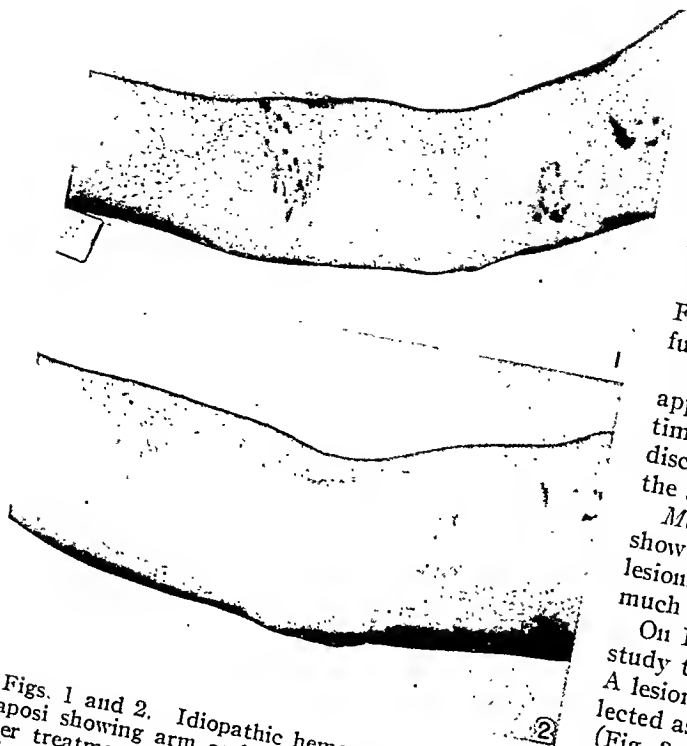
Figs. 2-5. Aberrant pancreatic tumor in the duodenal wall. Fig. 2. Right lateral view showing only a small amount of barium in the duodenal loop, irregularly distributed in its lumen. Fig. 3. Gas-filled pocket in the right lumbar region. Fig. 4. Normal stomach and dilated duodenum. Fig. 5. Right lateral view showing contour deformity of ascending portion of the duodenum and stenosis.

the lines of force would travel as directly as possible through the region of the tumor. The positive electrode was made as small as possible but large enough to cover the entire tumor area. The purpose of this arrangement was to produce the greatest possible current density at the site of the lesion. The x-rays were directed through the positive electrode into the tumor area. The plan followed was to give direct current first for about ten minutes, then to begin x-ray irradiation while the current was still on and continue both until the

desired x-ray dose (150 r) had been delivered. Direct current was applied to the limit of tolerance as judged by the sensation of pain or discomfort.

V. R., a 67-year-old Italian tailor, was admitted because of edema of the left lower extremity and widespread involvement of the skin by the bluish tumors characteristic of hemorrhagic sarcoma. The patient had first noticed these lesions about five years prior to admission.

Examination showed a brawny edema of the left lower leg and foot with purplish discoloration of the skin of that area. On the left plantar surface were numerous hemorrhagic verrucous lesions. The right foot also showed diffuse involvement by lesions of



Figs. 1 and 2. Idiopathic hemorrhagic sarcoma of Kaposi showing arm and forearm lesions before and after treatment. After the combined treatment the lesions on the forearm show flattening and increased pigmentation as compared to the results of simple radiation of same dosage (1,500 r) to the upper arm lesion (three weeks after treatment).

the hemorrhagic type, but this foot was not indurated or swollen. The right hand and wrist were edematous and indurated and several small hemorrhagic nodules protruded from the skin on the dorsum of the wrist. Scattered widely on different areas of the body were numerous circinate areas of purple color. Each area was made up of confluent groups of small, round, firm subcutaneous hemorrhagic nodules which faded only slightly on pressure.

The patient was studied completely for systemic involvement, and all laboratory findings were negative, including blood serologic tests. Biopsy of lesions similar to those treated revealed a picture characteristic of hemorrhagic sarcoma of Kaposi, showing dense new capillary formation with increased cellular infiltrate, the so-called second phase of this type of tumor.

On Jan. 25, 1943, two areas on the patient's right arm (Fig. 1) were selected for treatment. The upper arm lesion, which measured $2 \times 3/4$ in. and was fairly prominent, was used as a control, being treated with routine x-ray therapy, with factors as indicated above. The more prominent forearm area, which measured $3 3/4 \times 1 1/2$ in. and protruded above the level of the skin, was given the combined therapy. Ten daily treatments were given to each area. The following progress notes were recorded.

Feb. 5: Definite area of erythema present over right forearm, more marked than over upper arm area (control area).

Feb. 16: Intense erythema of forearm area evident and fading erythema on upper arm area. Both lesions have decreased appreciably in size.

Feb. 23: Erythema of forearm fading but still marked. Forearm lesion flatter and fading out. Upper arm lesion also is fading out; no erythema.

Feb. 28: Erythema of forearm almost gone. Forearm lesion is still receding (Fig. 2). There is no further decrease in size of upper arm lesion.

March 14: Erythema of forearm area has disappeared. Lesion has receded still more since last time. It is completely flattened out and only a faint discolored area remains. Upper arm area is about the same as on previous examination.

March 27: Right upper and lower arm lesions show no change. The amount of regression in the lesions is hard to compare. At present each appears much the same as before.

On Feb. 5, 1943, two more areas were chosen to study the comparative effects of the two methods. A lesion of the left upper thigh (Fig. 3, B) was selected as the control area, and one on the right hip (Fig. 3, A) as the experimental area. Both lesions were of about the same size, measuring $2 3/4 \times 2$ inches and $2 3/4 \times 1 1/4$ inches, respectively. Both were equal in prominence as judged by induration and protrusion beyond the skin level, and both appeared clinically to be in the same phase. The total x-ray dosage and the size of the portal were the same in each case. The patient was co-operative, and treatments were given daily according to the routine described above. The following progress notes were recorded.

Feb. 14: Erythema on hip (combined therapy). No erythema on control area.

Feb. 23: Erythema on hip is marked while that of thigh is fading. Lesions appear unchanged in size.

Feb. 28: Erythema of hip area is now intense (Fig. 3, C) and vesicular. Lesion is obliterated by the intense reaction. There is no erythema of left thigh area and lesion appears slightly flattened and less pronounced (Fig. 3, D).

March 14: Erythema of hip is fading but still evident. Only a faint outline of the lesion is present. Left thigh area shows no erythema. Lesion is still very prominent, but appears smaller and flatter.

March 27: Hip exhibits little evidence of any lesion (Fig. 3, E). Erythema is gone. On the left thigh, the residual lesion is still present (Fig. 3, F).

COMMENT

Evaluation of the comparative effects of the two types of treatment on the arm areas was made difficult by the difference in the size and relative prominence of the lesions and the difference in size of the tube

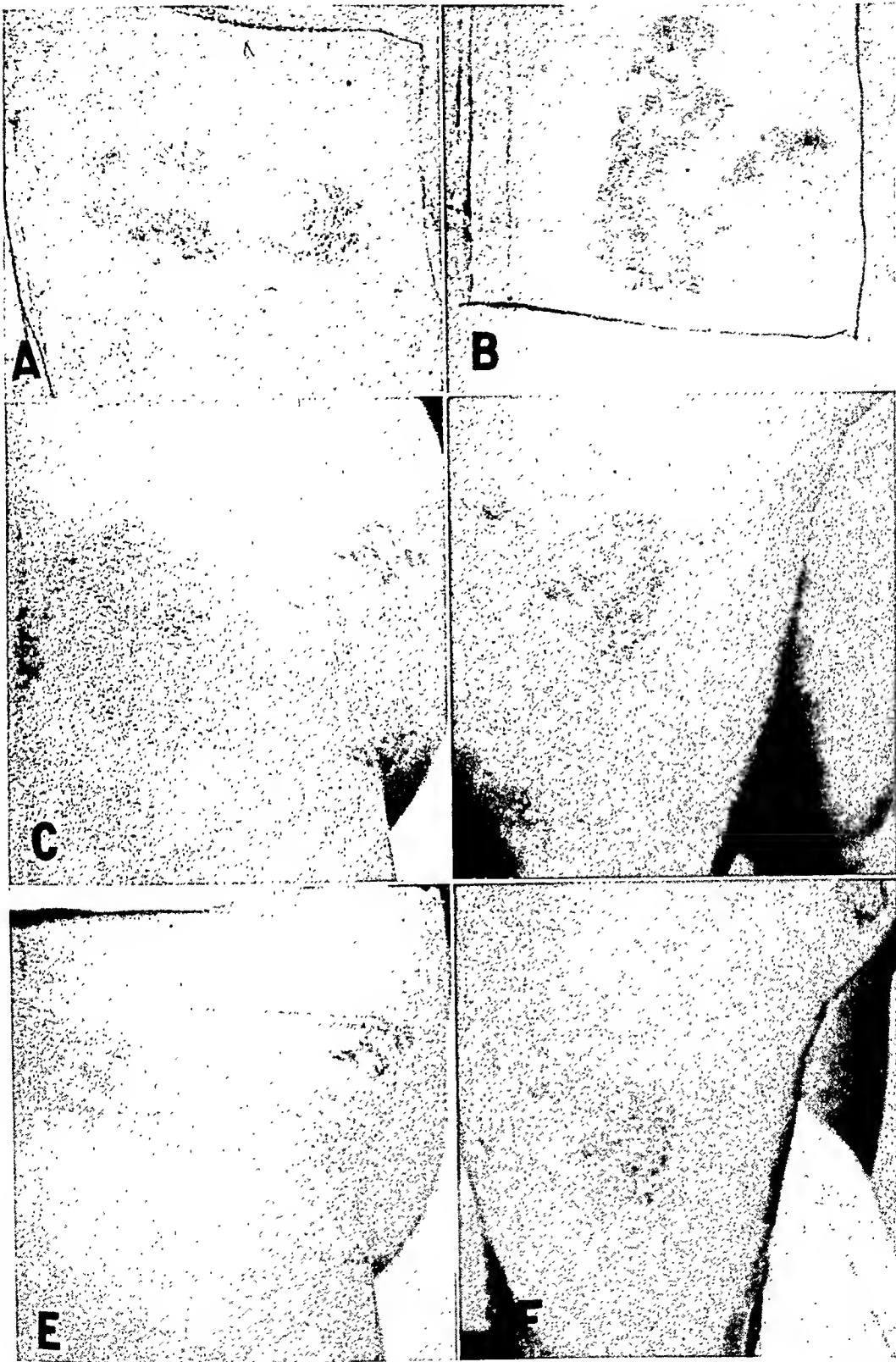


Fig. 3. A. Right hip area before treatment. B. Left thigh area before treatment. C. Right hip area ten days after combined treatment was completed (1,500 r), showing intense erythema. D. Left thigh area taken at same time as C, showing slight erythema following x-ray therapy alone. E. Right hip six weeks after combined treatment was completed, showing slight residual. F. Left thigh area taken at same time, as E, showing definite residual reaction.

portals. Even though the experimental area was larger to start with and more prominent, it still showed some greater degree of recession than did the control area. The second pair of lesions was more satisfactory for comparison because, as noted above, the areas were of about the same size and prominence, and the size of the portals was exactly the same. In this pair, a much greater amount of residual disease was noted in the control area than in the experimental area.

Although this case was very suitable for our experimental purposes because of the multiplicity of similar lesions, the characteristic radiosensitivity of the tumors was a handicap, since the control areas could be expected to respond to x-ray alone and the differences in response would be difficult to measure. However, certain appreciable differences did emerge from the two types of treatment. First, the skin erythema produced by the combined treatments appeared earlier, was much more intense, and persisted longer. This may have been due to the fact that D.C. therapy produced electrolytic effects near the electrode, and this, plus skin irritation, caused a hyperemia which increased scattering and thus increased the effects of irradiation.

On the other hand, these differences may be due to the increase in radiosensitivity by prolongation of ionization. This of course, will require further study. Second, the experimental combined treatment areas showed a greater response than did the control areas.

Although I have employed this combination of direct current and x-rays in four other types of malignant tumor since 1937 none of these was studied as completely as this case of hemorrhagic sarcoma of Kaposi.

CONCLUSIONS

A case of hemorrhagic sarcoma of Kaposi was treated by x-ray therapy combined with local galvanic current to the lesion. In spite of the radiosensitivity of these tumors, it was possible to detect definite differences in the erythema produced by and the clinical response to the combined treatment as compared with control lesions treated by x-ray therapy alone.

NOTE: The author is grateful to Dr. H. L. Claassen and Dr. Leon Goldman for their help and encouragement, to Dr. Anthony C. Cipollaro for his critical review and suggestions for future studies, and to Dr. Ira I. Kaplan, under whose direction this project was started.

Cincinnati General Hospital
Cincinnati 29, Ohio



EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

Anesthetics Used in Connection with Roentgenology

Only occasionally is the anesthetist faced with the necessity of administering an anesthetic agent while roentgenologic equipment is in use and sparks are therefore being generated. When such a necessity arises in the hospital, it is usually either in the operating room or the roentgenologic laboratory. Whatever the situation in the hospital, the anesthetist is always aware that where there is a spark there is danger of explosion. Such a disaster is so serious that no avoidable risks of it should be taken and no possible precautions against it omitted (1, 2, 3). The precautions are both positive and negative.

Among the negative measures, the first can be stated in the form of a rule: No inflammable anesthetic agent should be administered in a room where roentgenologic equipment is being used. Accordingly, some of the commonly employed agents that should *not* be used near "live" roentgenologic equipment include ether, alone or in combination with any other gas, ethyl chloride, and cyclopropane. Moreover, use of chloroform in these circumstances is not advised, although that agent is not inflammable. The darkened condition of the room makes it impossible to observe the patient well.

Of the positive safety measures, perhaps the first is the following: When roentgenologic equipment is brought into the operating room, the regular machine for administering nitrous oxide, which is equipped with an ether bottle, should be removed from the room and a special nitrous oxide-oxygen machine, not equipped with an ether bottle, should be substituted. This same special machine is the

one to be used in the roentgenologic laboratory if nitrous oxide is to be administered.

Further positive measures have to do with the choice of agent or method and, in some cases, with dose and technique. Some years ago it was not easy to find a safe anesthetic agent or method for use when roentgenologic equipment had to be employed. The range of choice was limited. Now, however, the range of choice is wide, and there is no good excuse for departing from safe principles. Where roentgenologic equipment is in use, therefore, local, regional, spinal, or intravenous methods of anesthesia may be employed, with agents appropriate to these methods; if it is desirable to employ the inhalation method, the agent should be nitrous oxide, combined with oxygen but without ether. Preliminary medication also is desirable. With morphine or atropine given by hypodermic injection and pentobarbital sodium (nembutal) given by mouth, it is possible to control the patient by means of nitrous oxide and oxygen, without ether. An additional agent and method come up for consideration when a child who has aspirated a foreign body into the trachea is to be subjected to bronchoscopy. Under these circumstances solution of tribromoethanol (avertin with amylene hydrate) is administered by rectum, the usual dose being 100 mg. per kilogram of body weight. Preliminary medication is not used in such cases.

Because of the current favor in which intravenous anesthesia is held, it merits special consideration. Intravenous anesthesia may be used where roentgenologic equipment is employed, but the agent

must be given in small doses so that the patient's invisible breathing can be heard and anoxemia eliminated in so far as possible. Intravenous anesthesia, nitrous oxide 50 per cent and oxygen 50 per cent, and preliminary medication, make a safe combination that may be used under practically all circumstances. Probably this is the method of choice for use under the circumstances here discussed.

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JOHN S. LUNDY, M.D.
Mayo Clinic

ANNOUNCEMENTS AND BOOK REVIEWS

CANCER TEACHING DAY

Tuesday, Oct. 17, will be observed as Cancer Teaching Day at Ithaca, New York, the program being presented under the auspices of the Medical Society of the County of Tompkins, the Medical Society of the State of New York, and the Division of Cancer Control of the New York State Department of Health.

At the afternoon session (4 P.M.) Dr. John H. Garlock of Mt. Sinai Hospital, New York City, will speak on Carcinoma of the Colon, and Dr. John J. Morton of Strong Memorial Hospital, Rochester, on Bone Tumors. The speakers at the evening session will be Dr. Andrew H. Dowdy, of the University of Rochester, on Epithelioma of the Skin, and Dr. Frank Adair of Memorial Hospital, New York City, on Carcinoma of the Breast.

OHIO RADIOLOGICAL SOCIETY

At the annual meeting of the Ohio Radiological Society, officers for 1944-45 were elected as follows: President, Clarence E. Hufford, M.D., Toledo; Vice-President, Harold G. Reincke, M.D., Cincinnati; Secretary-Treasurer, Henry Snow, M.D., Dayton. Ralph W. Holmes, M.D., of Chillicothe, and John Newton, M.D., of Cleveland Heights, were elected to the Executive Council.

PITTSBURGH ROENTGEN SOCIETY

The newly elected officers of the Pittsburgh Roentgen Society are as follows: President, William J. McGregor, M.D., Pittsburgh; Vice-President, James R. Gemmill, M.D., Monesson; Secretary-Treasurer, Lester M. J. Freedman, M.D., Pittsburgh.

INFORMATION FOR AUTHORS

RADIOLOGY has recently prepared a booklet of Information for Authors, including suggestions for improved illustrations. The Editor will be glad to send a copy of this, upon request, to anyone who anticipates contributing to this journal.

In Memoriam

RUDOLPH JEROME PRICE, M.D.
1895-1944

Dr. Rudolph Jerome Price of Dayton, Ohio, died on June 8th as a result of injuries sustained in an automobile accident. Doctor Price was born in Richmond, Indiana, in 1895. He was graduated

from Earlham College in 1918 and from the University of Michigan Medical School in 1923. He received the French Croix de Guerre for his services in the First World War and had recently been appointed by the Army as a consultant at Wright Field. He was radiologist at the Good Samaritan Hospital, Dayton, and secretary of the Dayton Hospital Board.

Doctor Price was a diplomate of the American Board of Radiology and a member of the American College of Radiology, the American Roentgen Ray Society, and the Radiological Society of North America.



Frederick C. Martin

FREDERICK C. MARTIN
1884-1944

Radiologists throughout the country will learn with sincere regret of the death, on Aug. 20, after a prolonged illness, of Frederick C. Martin, manager of the Eastman Kodak Company's Medical Sales Division.

Mr. Martin was born in Philadelphia sixty years ago. He had been associated with the Eastman Kodak Company since 1916 and head of the Medical Sales Division since 1929. He was a familiar figure at gatherings of radiologists, where he presided as a genial host over the exhibits of the Eastman Kodak Company. To his technical knowledge and unfailing co-operation many in our specialty are deeply indebted. His helpful counsel and friendly service will be greatly missed.

Books Received

Books received are acknowledged under this heading and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE GASTRO-INTESTINAL TRACT. A HANDBOOK OF ROENTGEN DIAGNOSIS. By FRED JENNER HODGES, B.S., M.D., Professor of Roentgenology, University of Michigan Medical School, Ann Arbor, Michigan. A volume of 320 pages, with numerous illustrations. Published by The Year Book Publishers, Inc., 304 S. Dearborn St., Chicago, Ill. Price \$5.50.

THE PRACTICE OF MEDICINE. By JONATHAN CAMPBELL MEAKINS, M.D., LL.D., Brigadier, Deputy Director General of Medical Services, Royal Canadian Army Medical Corps; Professor of Medicine and Director of the Department of Medicine, McGill University; Physician-in-Chief, Royal Victoria Hospital, Montreal; Formerly Professor of Therapeutics and Clinical Medicine, University of Edinburgh; Fellow of the Royal Society of Edinburgh; Fellow of the Royal Society of Canada; Fellow of the Royal College of Physicians, London; Fellow of the Royal College of Physicians, Edinburgh; Honorary Fellow of the Royal College of Surgeons, Edinburgh; Fellow of the Royal College of Physicians, Canada; Fellow of the American College of Physicians; Honorary Fellow of the Royal Society of Medicine. A volume of 1,444 pages, with 517 illustrations, including 48 in color. Published by the C. V. Mosby Co., St. Louis, Mo. Fourth Edition, 1944. Price \$10.00.

Book Reviews

THE PATHOGENESIS OF TUBERCULOSIS. By ARNOLD R. RICH, M.D., Associate Professor of Pathology, The Johns Hopkins University School of Medicine, Baltimore. A volume of 969 pages; 35-page index; 89 figures; 20 tables; 1417 references; 4 charts. Published by Charles C. Thomas, Springfield, Ill. Price \$10.50 postpaid.

In the course of clinical observations and experimental investigation a great wealth of data accumulates along with conclusions and deductions, some of which rest on safe grounds and others on questionable evidence and unjustified generalizations and extrapolations. The result is not infrequently a chaotic mass of statements, of contradictions and controversies. Many workers in the field of tuberculosis have felt that such a state of affairs has been reached in the most fundamental field of tuberculosis research concerning the pathogenesis of the disease. That this is so is obvious when it is re-

called that primary infection is considered absolutely benign by some authors and potentially most dangerous by others; that it is believed by some to confer upon its bearer protection against later infection, while other workers claim that it increases the vulnerability to subsequent infections. Examples of such unsolved controversies could be multiplied.

Doctor Rich, with his associates, has contributed significant studies to the pathogenesis of tuberculosis since 1929. Even his first paper in this field questioned and attacked established concepts and gave evidence that he had critically approached his problems. One may assume that in the intervening fifteen years he has spent much time and thought in digesting past and current publications, in critically analyzing the data from the literature as well as his own experimental studies. The result is a monumental book in which the available knowledge has been scrutinized, probed, and resynthesized in a more thorough and searching manner than ever before. He has furnished a profoundly satisfying study of the problem. All factors operative in producing and modifying tuberculosis are carefully analyzed: the bacillus, as to its biochemical activities, its dosage and virulence; the host as to his native and acquired resistance against the background of environmental conditions.

The style is clear and lucid and this reviewer found the book stimulating and, at times, exciting. Doctor Rich takes many excursions away from tuberculosis into general pathological and biological principles; this adds validity and a broader interest.

The aim of this critical analysis was not, and could not have been, a definitive solution of all controversial matters and open problems. It was rather an attempt to bring order and clarity out of the existing chaos, to form plausible and consistent working hypotheses, to separate acceptable facts from non-acceptable fancy, to show clearly where knowledge is incomplete and where further study is necessary. This reviewer believes that Doctor Rich has in all essentials achieved his aims.

Controversy and disagreements will, of course, continue; but they may now proceed on a field that has been well cleared of worthless rubble; and the lines of possible controversy are better defined. In various phases of the problems one may arrive at somewhat different conclusions than Doctor Rich has reached. This, I believe, is mainly due to the fact that one may differ with him in regard to the emphasis he gives to certain sets of facts. Every worker naturally puts the greatest confidence in his own working tools. Doctor Rich's are those of experimental pathology. Others may feel, as does this reviewer, that evidence derived from clinical, roentgenological, and pathologico-anatomical work might well have been given more weight. If this had been done, the whole structure and content of this book would have provided many more obvious applications to practical work in tuberculosis. But there should be no mistake about this: anybody who is really inter-

ested not only in knowing the disease tuberculosis but in understanding it should read and study this volume. The most fundamental facts and interpretations of the mechanism of tuberculosis are here, even if the author does not always provide the few intervening steps between fundamentals and practice. If you think that understanding is a pertinent function of knowledge, you will want to read Doctor Rich's book.

TUBERCULOSIS OF THE EAR, NOSE, AND THROAT: INCLUDING THE LARYNX, THE TRACHEA, AND THE BRONCHI. By MERVIN C. MYERSON, M.D., New York City. A volume of 291 pages, with 89 illustrations. Published by Charles C Thomas, Springfield, Ill. Price, \$5.50.

From an experience with over ten thousand cases of tuberculosis, Doctor Myerson has prepared this concise monograph. In the first half he discusses a thousand cases of tuberculosis of the larynx; the second half is devoted to tuberculosis of the ear, nose, oral cavity, tongue, tonsil, pharynx, esophagus, trachea, and bronchi.

In his Introduction the author states his purpose: "to bring up-to-date our knowledge of tuberculosis of the structures which come under the care of the otolaryngologist and bronchoscopist . . . to serve all those whose studies and interests encompass the field of tuberculosis of the upper and lower respiratory passages." He has produced a most practical volume for the busy specialist in the field of otolaryngology. It is well illustrated with drawings and photographs, and appropriate case histories are included.

ATLAS OF OVARIAN TUMORS. By GEMMA BARZILAI, M.D. New York City. Preface by FRED W. STEWART, M.D., Pathologist, Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York City. A volume of 264 pages with 258 original illustrations, 45 in colors on 58 plates. Published by Grune & Stratton, 443 Fourth Ave., New York, N. Y. Price (cloth) \$10.00.

Doctor Barzilai's Atlas of Ovarian Tumors is a clear, concise, well organized, and thoroughly illustrated loose-leaf handbook.

The consideration includes a comprehensive classification according to developmental and cyclic phases of the graafian follicle; structures traceable to the different stages of the development of the male gonad; structures traceable to the early mesenchymal core of the ovary; structures traceable to a totipotent cell; structures traceable to tissue normally found in the extrafollicular portion of the ovary; structures belonging to organs that are nor-

mally adjacent to the ovary; and lastly secondary tumors.

The subject matter on each tumor has a convenient marginal index indicating the comprehensive consideration of all the phases in which the clinician and pathologist might be interested. This uniform method of discussion with indexing is especially helpful for comparison of the various ovarian neoplasms.

The fifty-eight plates showing histologic structure are excellent and with the exact descriptions give the Atlas maximum teaching value. Every pathologist and every medical library will find frequent use for this contribution to the relatively new field of tumors of the endocrine glands.

PSYCHIATRY AND THE WAR. A SURVEY OF THE SIGNIFICANCE OF PSYCHIATRY AND ITS RELATION TO DISTURBANCES IN HUMAN BEHAVIOR TO HELP PROVIDE FOR THE PRESENT WAR EFFORT AND FOR POST WAR NEEDS. Edited by FRANK J. SLADEN, M.D., Physician-in-Chief, Henry Ford Hospital, Detroit, Michigan; Trustee, McGregor Fund. A volume of 505 pages. Published by Charles C Thomas, Springfield, Ill. Price \$5.00.

This book is a carefully assembled record of the Conference on Psychiatry held at Ann Arbor, Michigan, October 22, 23, and 24, 1942, at the invitation of the University of Michigan and the McGregor Fund. The conference material is presented in five parts, which makes for ease of reference. The headings for the subject matter dealt with in each part are simple and explicit. Under the first head, "The Philosophy of Psychiatry," psychiatry is defined and its relation to psychology, medicine, surgery, pediatrics, and geriatrics is reviewed by leaders in psychiatric thought. Research in Psychiatry; Psychiatry in the Training, Experience, and Education of the Individual, and Psychiatry and the War are in turn painstakingly discussed. In part V follow two symposia which have for their purpose the synthesis and application of the thoughts expressed in the more formal presentations. The volume closes with an index of 49 pages which is sufficiently detailed to be of real reference value. A unique and helpful characteristic of the book is the epitomizing summary in terse words or phrases at the beginning of each of the formal articles. Incidentally, it may be remarked that the volume represents not only good editing but also good bookmaking.

This book, as a record of the thoughts and the judgments of many of the leaders in psychiatry and kindred fields, includes in its pages the dynamics for the formulation of thoroughgoing perspectives and the crystallizing of constructive attitudes. It merits thoughtful perusal by the serious minded, including physicians, educators, sociologists, administrators, and men of research.

Books Received

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THE PATHOGENESIS OF TUBERCULOSIS. By ARNOLD R. RICH, M.D., Associate Professor of Pathology, The Johns Hopkins University School of Medicine, Baltimore. A volume of 969 pages; 35-page index; 89 figures; 20 tables; 1417 references; 4 charts. Published by Charles C. Thomas, Springfield, Ill. Price \$10.50 postpaid.

In the course of clinical observations and experimental investigation a great wealth of data accumulates along with conclusions and deductions, some of which rest on safe grounds and others on questionable evidence and unjustified generalizations and extrapolations. The result is not infrequently a chaotic mass of statements, of contradictions and controversies. Many workers in the field of tuberculosis have felt that such a state of affairs has been reached in the most fundamental field of tuberculosis research concerning the pathogenesis of the disease. That this is so is obvious when it is re-

called that primary infection is considered absolutely benign by some authors and potentially most dangerous by others; that it is believed by some to confer upon its bearer protection against later infection, while other workers claim that it increases the vulnerability to subsequent infections. Examples of such unsolved controversies could be multiplied.

Doctor Rich, with his associates, has contributed significant studies to the pathogenesis of tuberculosis since 1929. Even his first paper in this field questioned and attacked established concepts and gave evidence that he had critically approached his problems. One may assume that in the intervening fifteen years he has spent much time and thought in digesting past and current publications, in critically analyzing the data from the literature as well as his own experimental studies. The result is a monumental book in which the available knowledge has been scrutinized, probed, and resynthesized in a more thorough and searching manner than ever before. He has furnished a profoundly satisfying study of the problem. All factors operative in producing and modifying tuberculosis are carefully analyzed: the bacillus, as to its biochemical activities, its dosage and virulence; the host as to his native and acquired resistance against the background of environmental conditions.

The style is clear and lucid and this reviewer found the book stimulating and, at times, exciting. Doctor Rich takes many excursions away from tuberculosis into general pathological and biological principles; this adds validity and a broader interest.

The aim of this critical analysis was not, and could not have been, a definitive solution of all controversial matters and open problems. It was rather an attempt to bring order and clarity out of the existing chaos, to form plausible and consistent working hypotheses, to separate acceptable facts from non-acceptable fancy, to show clearly where knowledge is incomplete and where further study is necessary. This reviewer believes that Doctor Rich has in all essentials achieved his aims.

Controversy and disagreements will, of course, continue; but they may now proceed on a field that has been well cleared of worthless rubble; and the lines of possible controversy are better defined. In various phases of the problems one may arrive at somewhat different conclusions than Doctor Rich has reached. This, I believe, is mainly due to the fact that one may differ with him in regard to the emphasis he gives to certain sets of facts. Every worker naturally puts the greatest confidence in his own working tools. Doctor Rich's are those of experimental pathology. Others may feel, as does this reviewer, that evidence derived from clinical, roentgenological, and pathologico-anatomical work might well have been given more weight. If this had been done, the whole structure and content of this book would have provided many more obvious applications to practical work in tuberculosis. But there should be no mistake about this: anybody who is really inter-

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Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

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Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

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NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

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Ohio Radiological Society.—Secretary, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

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The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia 4. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Lester M. J. Freedman, M.D., 4800 Friendship Ave., Pittsburgh 24, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—Secretary, A. M. Popma, M.D., 220 North First St. Boise, Idaho.

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Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

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La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Proper and Improper Administration of Oily Nasal Sprays. Bruno L. Griesman. *Arch. Otolaryng.* 39: 124-136, February 1944.

Thirty-one patients between 6 1/2 and 66 years of age, with no history or evidence of upper respiratory infection, were studied roentgenographically to determine the mechanism of the transmission of intranasally sprayed oils from the upper to the lower respiratory tract. With the patient seated in a chair, a "flat" roentgenogram was made with the head in the desired position before the oil was administered, since calcifications of the laryngeal cartilages might interfere with the shadows cast by the oil mixtures and thus confuse the interpretation of the subsequent films. In some cases a 1 per cent solution of an ephedrine salt was first sprayed into the nostrils to shrink the tissues and permit freer distribution of oil. After the oil was sprayed into the nose, exposures were made at certain intervals—from a few seconds to several minutes after instillation—with the tube, the head, and the plate in exactly the same position, in order that the distribution and the gravitation of the oil might be seen.

This study showed that healthy persons, irrespective of age, may aspirate oil even in therapeutic dosage if the oil is improperly administered. The presence or the absence of tonsils and adenoids and the use of a 1 per cent solution of an ephedrine salt prior to the administration of oil apparently do not increase the danger of oil aspiration. Scarring in the tonsillar beds and injury to the posterior pillars after tonsillectomy tend to increase the danger of oil aspiration if the oil is incorrectly administered. Oil is carried downward by the force of gravity. The decisive factor of safety is the position in which the head is held during and after the administration of oil. The danger begins and increases with the size of the angle of the backward inclination of the head. There is no danger when the head is held straight or bent forward, even when massive doses many times the normal therapeutic dose are employed. The factor of safety increases with the size of the angle of the forward inclination of the head.

An Enquiry into the Causation and Characteristics of Cephalhematomata. J. Blair Hartley and C. W. F. Burnett. *Brit. J. Radiol.* 17: 33-41, February 1944.

Three types of cephalhematoma may be recognized, external, internal, and subaponeurotic. This study concerns only the first. The condition is rare, appearing, according to Sjövall (*Acta obst. et gynec. Scandinav.* 15: 443, 1936), in about 0.41 per cent of births. According to this same writer, the right parietal bone is involved in 48 per cent of the cases, the left in 36 per cent, both parietals in 11, and the occipital in 1 per cent. The condition is more common in first-born children, but there is no consistent relation to difficult labors.

Radiological studies of cephalhematomata are few. The authors present 5 cases, in all of which radiographs of the skull were made. Their observations confirm those of others regarding the non-overlapping of the bone margins by the effusion and the occurrence of calcification first and in maximal degree at the summit of the effusion and subsequently from the bony and peri-

cranial aspects, leaving the center of the swelling unossified; later, when ossification finally occurs in large cephalhematomata, the final picture resembles the inner- and outer-table effect of the adult skull.

As to the etiologic factors suggested by their study, the authors say: "We venture to suggest that trauma of a dragging nature is the precipitating factor in causation, but that defective development of the vault bones and hypoprothrombinemia may also play a part; the hemorrhages may be small and recurrent, and may occur before labour, during labour at the level of the inlet and also the outlet, or in certain instances at both, or be delayed until after labour." In view of the possible role of hypoprothrombinemia, the authors recommend that treatment include a single dose of 10 mg. vitamin K analogue (2-methyl-1:4 naphthoquinone) immediately upon the discovery of the lesion, since such a dose is known to be effective in preventing any appreciable fall in the prothrombin concentration of the infant.

SYDNEY J. HAWLEY, M.D.

Normal Air Encephalograms in Patients with Convulsive Seizures and Tumor of the Brain. H. Houston Merritt and Charles Brenner. *New England J. Med.* 230: 224-225, Feb. 24, 1944.

The development of convulsive seizures in adults is considered to be due to irritation of the cerebral cortex. In seeking the cause of this irritation a ventriculogram or encephalogram is made to determine the appearance of the ventricles. Should the ventricular system be normal, the possibility of a neoplasm is believed to be excluded. The authors, however, present the complete case histories of 3 patients in whom normal appearing ventricular systems were demonstrated seven, twenty, and thirty months, respectively, after the initial convulsive seizure but in whom brain tumors were subsequently proved. The conclusion is that a negative report of an encephalogram should not be considered as definitely excluding the possibility of a neoplasm.

JOHN B. McANENY, M.D.

Rupture of a Left Temporo-Sphenoidal Brain Abscess into the Ventricle: Report of a Case, with Recovery. Louis E. Wolfson. *New England J. Med.* 230: 170-171, Feb. 10, 1944.

A 56-year-old blind man, who had a chronic left mastoiditis from the age of 5 years, contracted an upper respiratory infection with exacerbation of the mastoiditis and development of left facial paralysis. The left mastoid was opened and drained, with improvement. Five days postoperatively there was a rise of temperature and the patient became drowsy, with loss of motion in the right arm and leg. The operative site was reopened and the dura and brain were incised. A cannula was inserted for a distance of 3 cm. and pus was obtained. The drain was left in place. Half an hour after drainage, the paralysis began to clear.

In an effort to determine the extent and character of the infected area, lipiodol was instilled, defining the drainage area, which was found to extend into the left lateral cerebral ventricle.

The patient recovered and returned to work. Re-examination showed the lipiodol in the ventricular system.

JOHN B. McANENY, M.D.

THE CHEST

Control, Duplication and Standardization of Radiographic Chest Technique. Wm. H. Weidman and Jean Kieffer. *Am. Rev. Tuberc.* 49: 203-226, March 1944.

In comparing serial chest films, particularly in the study of tuberculous lesions, it is essential that the technical quality be as nearly comparable as possible. A method is described whereby a duplication of chest technic is possible within a limit of plus or minus 2 kv.p. from expected results, in approximately 93 per cent of a large series of films. For this purpose a step tablet is used consisting of six steps made of copper foil 0.107 mm. thick. The steps measure 6×6 mm. each and are composed of 2, 3, 4, 5, 6, and 7 layers of foil, respectively. They are surrounded by a lead mask. The use of copper makes the step tablet thin enough so that it can be placed directly on the cassette without interfering with the movement of the cassette changer. At the radiographic range of 45 to 90 kv.p. these steps have approximately the same absorption as steps composed of a similar number of layers of 1/8 inch aluminum.

Any variation in tablet densities produced on different radiographs by a supposedly similar technic indicates variation in that technic, and proper analysis may often reveal the cause of the variations and indicate the necessary correction. Also, in serial studies of chest disease the correlation between the tablet images on two films taken at different times affords an accurate indication of the relation between the total technics used on the two occasions.

In addition, a set of standards was prepared consisting of tablet images taken at 2 kv.p. intervals and covering the entire range of technic routinely used. These were developed with extreme care, with standard darkroom procedure and exact control of temperature, development time, and agitation. By this means a standard was obtained consisting of tablet images of various densities, with each image representing the result expected from the standard technic. Routine comparison of films taken subsequently against this standard shows immediately whether or not the result of the technic used for each finished film was exactly as expected and, if not, how great was the departure from expected results. When such a technic is employed, at least 80 per cent of all films fall within limits of plus or minus 2 kv. Should less than 70 per cent of them fall within these limits, the cause of the discrepancy should be investigated. When the films match a tablet image standard within narrow limits as to contrast but show marked variation in density, variations in exposure are indicated. The most common cause is an inaccurate timer; next, the use of cassettes of different speeds, and finally rapid fluctuations in line voltage occurring between the setting of the machine and the actual exposure. When the films show marked differences in contrast as well as density, variations in processing are indicated. In the average laboratory such variations in the processing procedure are by far the most common cause of lack of duplication.

L. W. PAUL, M.D.

Discussion of the Organization of a Fluorographic Service for the Civilian Community. Maurice Davidson, Peter Kerley, *et al.* *Proc. Roy. Soc. Med.* 37: 185-192, March 1944.

The problems expected to arise in organization of a mass fluorographic service for civilians were discussed

before the Section of Radiology of the British Royal Society of Medicine.

Dr. Maurice Davidson stated that the practical difficulties of mass radiography by standard methods can be surmounted by the use of miniature films, which can then be projected on a screen and enlarged to permit recognition of abnormal shadows. He emphasized that the diagnosis is not to be made from these films, but those found suspect are to be referred for complete examination by standard methods. Because of the fatigue element, a definite limit should be set as to the number of films examined at one sitting.

Doctor Davidson's primary interest is in the importance of this work to social medicine, and he advocates the universal adoption of mass radiography as a necessary contribution to preventive medicine, particularly the prevention of tuberculosis. One of the problems in obtaining the adoption of such a service is to get the support and backing of the entire medical profession. Too many clinicians fail to understand that active pulmonary tuberculosis may be entirely symptomless. The problem of medical ethics is raised, since, when the diagnosis of tuberculosis is made, the knowledge is a matter of professional confidence. How it can be made useful without violation of medical ethics, how treatment is to be carried out on patients requiring it, and how patients and their dependents are to be compensated for loss of earnings are other questions incompletely answered. Obtaining the co-operation of the groups to be examined may also be a problem.

Dr. Peter Kerley discussed the equipment, the constitution of the team, and the arrangements for disposal of the pathological cases. The recommended equipment consists of a 400-ma. four-valve unit energizing a rotating anode tube. The camera is automatic with a 1.5 coated lens. Eventually each unit should have its own mobile generator. An experienced team can easily handle 1,500 cases a week.

Dr. P. D'Arcy Hart, who spoke from his experience in factories and offices, pointed out that mass radiography is in general favor among working people, but propaganda is required in individual units. This is best carried out through shop stewards and through individual leaflets in pay packets. Agreement should be obtained from the management as to the confidential nature of the results.

Wing-Commander R. R. Trail called attention to the need for available sanitarium, outpatient, and hospital facilities before the chest surveys are made so that there will be no delay in treatment and so that proper follow-up will be possible.

Dr. L. Bansky was not in agreement with Doctor Hart that explanation to the workers is necessary before radiographic examination of the chest is carried out. In his experience fluoroscopic examination was done as part of the medical examination. When the presence of tuberculosis was established, the patient was sent to a public hospital for confirmation of the diagnosis. If the patient had to leave the factory for sanatorium care, his job was held open for him until his condition permitted his return. No compensation had ever been asked for tuberculosis by the employees.

Dr. W. Allen Daley discussed the cost of equipment and maintenance for a mass-radiography unit. He found that the local electric supply cable was frequently inadequate and a special cable had to be put in. It is estimated that 100 extra sanatorium beds are needed for each mass radiography set in active use.

Dr. Philip Ellman emphasized the importance of close co-operation between technician, chest radiologist, and chest physician. He doubted that anyone could be trained in a few months to take the responsibility of correct interpretation of miniature films. He agreed that any scheme for a fluorographic service for the civilian population should be entirely dissociated from existing tuberculosis clinics.

Dr. Norman P. Henderson called attention to problems arising in connection with co-operation between the factory medical officer, the medical officer in charge of the mass radiographic unit, and the private physician. Thus treatment and follow-up are often difficult to accomplish after the diagnosis of disease has been made. He recommended organization of a series of regional examining boards of well qualified physicians to interpret the films and a central consultative board as a last source of appeal in difficult cases.

H. H. WRIGHT, M.D.

Chest Screening in an Ante-Natal Clinic. Rachel Frank and A. L. Jacobs. *Brit. M. J.* 1: 394, March 18, 1944.

The authors give a short but practical commentary on the procedure of chest fluoroscopy of ante-natal patients in a large clinic in England. The examination is rather brief and only 35 to 40 minutes a week are required to cover all incoming cases. Full-sized films are ordered whenever the screen findings are at all suspicious.

From a series of 1,125 cases screened in one year, certain significant figures were obtained. Sixty-three films were used in this series; 22 cases of active tuberculosis and 2 of possible tuberculosis were discovered in addition to various minor conditions of a non-specific type. It is also noted that inspection among the W.A.A.F.'s by miniature radiography disclosed 0.4 per cent requiring treatment and 0.6 per cent in need of observation.

In a final comment the authors state that the best method of mass chest examination is miniature radiography but that, in the absence of facilities, screen examinations are by no means to be despised. Several cases of heart disease were discovered by fluoroscopy.

Q. B. CORAY, M.D.

Demonstration of Pulmonary Lobes and Interlobar Fissures by Roentgenograms of an Artificial Thorax. E. M. Medlar, G. S. Pesquera, W. H. Ordway, and E. C. Lasher. *Am. J. Roentgenol.* 51: 267-279, March 1944.

It is often important to determine whether the initial lesions and the "spreads" of pulmonary tuberculosis are in the upper or the lower portions of the lobes of the lungs. The prominent position now held by thoracic surgery also calls for the location of pulmonary lesions in relation to the pulmonary lobes.

The authors obtained a pair of human lungs at necropsy, with complete interlobar fissures on both sides. The lungs were fixed by a process described in the paper. Plaster molds were made of each lung and of each lobe. An artificial thorax was constructed. To demonstrate the position, size, and shape of the interlobar fissures thin sheets of lead foil were placed between the lobes. Pathological processes were simulated in various locations and roentgenograms were taken.

It was found that horizontal planes through the

chest at the level of the fourth and sixth costovertebral junctions have a practical value when interpretations in relation to pulmonary lobes are under consideration. The practical value of interpretations of chest roentgenograms will be enhanced provided the following suggestions in relation to the two planes mentioned are used:

1. Pathologic processes above a horizontal plane at the level of the fourth costovertebral junction will be in the upper portions of the upper lobes. In tuberculosis the majority of lesions will be dorsal in position.

2. Below a horizontal plane at the level of the sixth costovertebral junction pathologic processes in the dorsal half of the chest will be in the lower lobes, especially if the main lesion abuts the dorsal surface of the chest cavity. Pathologic processes in the ventral half will be in the upper lobe on the left and in the middle lobe on the right.

3. The area between horizontal planes at the fourth and sixth costovertebral junctions represents the common variations of the upper edge of the main fissures on either side. If in this area the pathologic condition is present in the ventral two-thirds of the chest, the upper lobes are surely involved. If, however, the lesion adjoins the dorsal surface, involvement of the apex of the lower lobe must be seriously considered.

CLARENCE E. WEAVER, M.D.

Determination and Treatment of Pressure Cavities in Pulmonary Tuberculosis. Arthur M. Vineberg and Walter E. Kunstler. *Surg., Gynec. & Obst.* 78: 245-274, March 1944.

During a revision thoracoplasty for a residual cavity the authors needled the cavity and took manometric readings. To their surprise the intracavity pressure was high and from its fluctuations during respiration it was evident that the bronchus entering this residual cavity was partially blocked, the obstruction being of the check-valve type. It followed logically that they would suppose that the failure of the original thoracoplasty was due to the increased pressure within the cavity. This prompted a study of pressure cavities, and the present paper is the result of the authors' experience and an explanation of the instruments and technic they developed in 150 diagnostic cavity needlings and 27 therapeutic cavity drainages.

The historical background of pulmonary cavity formation is detailed and the physiological and mechanical factors in the growth of various types of cavities are explained and illustrated. The classification of Coryllos is followed: (1) the cavity with the open bronchus, permitting growth of tubercle bacilli and a positive sputum; (2) the closed cavity with negative sputum; usually shrinking in size as its air is reabsorbed; (3) the cavity with the check-valve type of obstruction causing increased intracavity pressure and concomitant ballooning out of the cavity.

Like Coryllos, the authors believe that the complete obliteration of the draining bronchus is essential in obtaining permanent closure of a cavity. They do not feel that films aid in the diagnosis of these cavities as pressure cavities. Nor can the thickness of the wall be determined, as in this type of cavity a portion of the seemingly thick wall is made up of adjacent atelectatic lung tissue.

When it becomes necessary to consider thoracoplasty to obliterate a tuberculous cavity in the lung, intracav-

ity pressure readings should be obtained. If these indicate the presence of a tension cavity, thoracoplasty as an initial measure should not be undertaken, but preliminary suction drainage should be done. The authors are emphatic, however, that suction drainage is not enough. Permanent closure necessitates thoracoplasty following drainage. In giant tension cavities where the parietal pleura has been reached, a preliminary relaxing anterior thoracoplasty precedes the cavity drainage. By these preliminary measures, the size of the cavity is reduced with salvage of normal lung tissue and therefore a greater final vital capacity for the patient. The cavity is rendered negative for tubercle bacilli, the draining bronchus is closed, and a less radical thoracoplasty is required.

The technic and instruments used for transthoracic needling and subsequent introduction of the catheter for drainage are fully described and generously illustrated. The safety of the method is stressed. In 150 cavity needlings and 27 cavity drainages there was not one instance of empyema, pneumothorax, hemorrhage, or air embolism.

J. FRANCIS MAHONEY, M.D.

Quantity of Focal (Tubercle) Calcium in Human Lungs. Paul E. Steiner, D. Warren Stanger, Miriam Bolyard, and A. W. Mareovich. *Am. Rev. Tuberc.* 49: 129-139, February 1944.

A method is presented for the quantitative determination of focal calcification in the lungs and other tissues, together with the results of its use in 119 pairs of human lungs. The method consisted in the preservation of the lungs removed at autopsy in alcohol, the volume of alcohol in cubic centimeters being equal to the weight of the lungs in grams. To this was added a 10 per cent aqueous potassium hydroxide solution equal in volume to that of the alcohol. Saponification was carried out by heating for twenty-four hours on a steam bath. The concretions fall to the bottom of the flask and can be removed by decantation. After removal they were washed several times with water, air dried, and weighed. Focal calcium was found in 88.8 per cent of the lungs examined, the average amount being 0.231 gm. The quantity and the incidence of positive cases increased sharply between the thirtieth and fifty-ninth years, but not thereafter. No important differences were detected in the quantity of calcium found in the two sexes or in rural and urban dwellers. The deposits were usually multiple.

In 50 cases a comparison of the reliability of this chemical method with roentgenograms in detecting calcified foci was made. In 78 per cent there was agreement, while in 11 cases, or 22 per cent, calcified foci were discovered chemically which the roentgenograms did not reveal. The causes of failure were chiefly concomitant disease in the chest and a small amount of focal calcium located outside of the lung fields. With roentgenograms it was possible to detect small calcified foci containing as little as 9 mg. of calcium when located in the lung field.

L. W. PAUL, M.D.

Intrabronchial Spread Following Thoracoplasty. Mandel Weinstein and Steven Tyau. *Am. Rev. Tuberc.* 49: 238-250, March 1944.

The importance of intrabronchial spread of tuberculosis following thoracoplasty is emphasized by a

study of the 198 thoracoplasty operations performed during 1942 at the Sea View Hospital. A total of 19 instances occurred, in 14 patients, giving an operative incidence of approximately 10 per cent. Four deaths were directly caused by the tuberculous spread, a mortality of 2 per cent. In 12 of the 19 cases the spread occurred after the first stage of thoracoplasty; in 6 it followed a second-stage thoracoplasty; and in only 1 did it develop after a third-stage operation. Age and sex had no bearing on the incidence or severity of the spread. The complication occurred more frequently in Negroes than in whites and all 4 patients whose deaths were directly contributed to by the spread were Negroes.

In 2 patients spread occurred in the contralateral lung in spite of the presence of therapeutic pneumothorax on that side. In 5 cases a spread occurred in the homolateral lung; in 10 to the contralateral lung; and in 4 the spread was bilateral. The middle and lower lung regions were the most frequent sites of involvement.

No single precaution or procedure known at the present time can eliminate this complication of thoracoplasty. The incidence and severity can be lessened, however, by proper selection of cases and by careful preoperative preparation. Preceding the operation, the patient should empty the bronchial tree well of all secretion, by cough and postural drainage. Patients should be anesthetized so that they react immediately following the procedure. Narcotics and sedatives should be used sparingly and infrequently. Those patients with extensive disease and much cavitory exudate are more prone to spread after thoracoplasty.

L. W. PAUL, M.D.

Silico-Tuberculosis. Oscar Auerbach and Marguerite G. Stemmerman. *Am. Rev. Tuberc.* 49: 115-128, February 1944.

In order to determine whether or not pneumoconiosis alters or is itself altered by pulmonary tuberculosis, the authors reviewed the autopsy and clinical findings in 54 cases of silico-tuberculosis and compared them with 9 cases of pneumoconiosis without tuberculosis and 200 cases of tuberculosis without pneumoconiosis. The results of the study are in some disagreement with the reported findings of others. Thus, clinically, the course of the disease, when silicosis and tuberculosis co-existed, was not appreciably different than when only tuberculosis was present. Also, the pathologic material showed little or no alteration in the appearance of the pulmonary tuberculosis when it was associated with silicosis. In all of the cases studied, the silicosis and tuberculosis could always be distinguished as two separate and independent processes. There was no evidence that the silicotic foci resulted from the inhalation of dust combined with tubercle bacilli. Nor was there any indication that the massive fibrosis in silicosis is usually the result of a tuberculous infection. There was no evidence of tubercles on microscopic examination within these areas of massive fibrosis, even though large areas of tissue were examined. However, tuberculous foci bordering the fibrosis were not unusual. Tuberculosis is altered by pneumoconiosis only in so far as the silicotic nodules prevent the full development of tuberculous granulation tissue and, in the walls of cavities, the pyogenic membrane. The size, situation, and number of cavities are approximately the same. There is a slightly greater incidence of perforation of the

cavities through the interlobar fissures in the silicotics and a greater incidence of death from fatal pulmonary hemorrhage. Most patients died of progressive pulmonary insufficiency. L. W. PAUL, M.D.

A Plea for the Prevention of Bronchiectasis. Karl Kornblum. *Am. J. Roentgenol.* 51: 292-314, March 1944.

This is a general discussion of bronchiectasis with emphasis on etiology and prevention. It should be read in the original. "In general," the author says, "two of the most useful and important procedures in the prevention of bronchiectasis are the roentgen examination of the chest and bronchoscopic examination. In every affection of the respiratory tract in which symptoms are persistent or do not readily respond to treatment, a roentgen examination is indicated, including the sinuses as well as the chest. This will frequently reveal conditions which, if promptly taken care of, will prevent the development of bronchiectasis...."

"Finally, in the prevention of bronchiectasis an educational program for both the laity and the medical profession is of prime importance...."

"In this educational program the roentgenologist has an excellent opportunity to render real service.... he has an opportunity to view the entire life history of bronchiectasis from the etiological stage to the terminal events. He can educate his colleagues regarding many of the pertinent facts of bronchiectasis, he can direct their attention to the possibility of a developing or the existence of an early bronchiectasis, and finally he can suggest a bronchoscopic examination when in his opinion this procedure is indicated. Thus, in the prevention of bronchiectasis, a roentgenologist who is conscious of and has a full knowledge of this disease is an asset of prime importance."

Pseudobronchiectasis. Brian Blades and David J. Dugan. *J. Thoracic Surg.* 13: 40-48, February 1944.

The authors have seen 6 cases in which a chronic productive cough persisted following so-called "atypical" or virus pneumonia and lipiodol filling of the bronchi showed a cylindrical type of bronchiectasis. The first patient encountered was transferred to the surgical service for lobectomy, but since the history was atypical, having started with the acute pneumonia a short time before, the operation was postponed. Two months later a bronchogram showed disappearance of the bronchiectasis and the symptoms had ceased. In the other 5 cases the history and roentgen findings were similar.

The exact method of development of the bronchiectasis is not understood at this time. It is important to remember, however, that temporary dilatation of the bronchi can occur following "atypical" pneumonia and may persist for as long as three months.

HAROLD O. PETERSON, M.D.

Primary Atypical Pneumonia (Virus Pneumonia). Robert C. Schnitz. *Wisconsin M. J.* 43: 228-233, February 1944.

A review of the signs, symptoms, and treatment of primary atypical or virus pneumonia is presented in concise and condensed form. A chart setting forth the features differentiating between this condition and lobar pneumonia, influenza, and bronchopneumonia is also included.

The roentgen findings, as has been repeatedly pointed out, are usually out of proportion to the physical findings. "The roentgen plate will become positive by the second and third days of the disease. It may simulate the picture of bronchitis and bronchopneumonia. The interstitial spread of the disease produces cottony shadows in the parenchyma. These smaller areas may coalesce to simulate lobar pneumonia except for the fact that the vascular and osseous markings are not obscured. There may be just a diffuse increase in density in one or more lobes, a wedge-shaped area of infiltration at one or both costophrenic angles, at the cardiohepatic angle, or in either or both of the hilar areas. The lower lobes are involved most frequently. During resolution, the plate may simulate that of tuberculosis."

Treatment is essentially symptomatic, the sulfonamide preparations having no specific effect. Transfusions of convalescent donors' blood are believed to be of definite value.

Two rather unusual case histories are given. Case 1 is that of a two-year-old girl admitted in a toxic state with cerebral symptoms, with bubbling rales over the entire chest but with a normal appearing chest roentgenogram. She died three hours after admission and autopsy revealed patches of consolidation in both bases. In Case 2 roentgen examination showed infiltration in only the right lung, although moist rales were present bilaterally. LESTER M. J. FREEDMAN, M.D.

Roentgenographic Manifestations of Atypical Pneumonia of Unknown Etiology. W. E. Crysler. *Am. J. Roentgenol.* 51: 280-291, March 1944.

This report is based on 178 cases of bronchopneumonia, demonstrated by roentgenographic examination, in personnel of the Royal Canadian Navy. Bacteriological studies, when done, revealed no positive pathogens. As a routine, postero-anterior and the appropriate lateral roentgenograms of the chest were obtained.

There was no notable relationship between the anatomical extent of the disease as shown in the roentgenograms and the severity of the symptoms. Pneumonic infiltrations were discovered in the enlistment roentgenograms of 12 recruits who had no complaints other than a recent "chest cold." A lag of two to three days was occasionally noted between the clinical and roentgen evidence of pneumonia. Eighty per cent of the lesions were confined to the lower lobes.

In almost all cases the parenchymal infiltration manifests itself by a peribronchial distribution. The lateral view often reveals a confluent bronchopneumonia radiating fanwise from the hilum. Early infiltration commences in one of two ways: First, an ill-defined blurred, localized structural accentuation occurs. The peribronchial blurring may extend and coalesce, producing a frank parenchymal infiltration. Accentuated structural markings are usually visible through this shadow. In the second method of development an area of localized accentuation is followed by the appearance of flocculent densities, peribronchial in distribution. Occasionally both homogeneous and flocculent densities are demonstrable in the same lesion. When regression of the infiltration is complete, the structural accentuation often recedes more slowly, being last to disappear.

Certain lesions, when confined to the upper lung

field, resemble pulmonary tuberculosis. Pleuritis with effusion is a rare finding. Lateral roentgenograms are helpful and important in localizing the process. In 21.3 per cent of the cases elevation of a hemidiaphragm was noted and was interpreted as evidence of atelectasis. With atelectasis, resolution is delayed.

Resolution is the rule. Accompanying atelectasis probably accounts for the rare development of bronchiectasis. Non-resolution with clinical evidence of asthma has also been observed. The clinical diagnosis at present should be "atypical pneumonia, etiology unknown."

CLARENCE E. WEAVER, M.D.

Acute Diffuse Interstitial Fibrosis of the Lungs. Louis Hamman and Arnold R. Rich. *Bull. Johns Hopkins Hosp.* 74: 177-212, March 1944.

Since 1931, 4 cases of pulmonary disease presenting a picture unfamiliar to physicians and pathologists have been observed at Johns Hopkins Hospital. The symptoms of each case differed somewhat from those of the others and yet bore a striking resemblance. The pathological process in the lungs was identical in all, and this lesion was so extraordinary and distinctive that there can be no doubt that the symptoms displayed by each case, different though they were, arose from the same underlying morbid process, their variation depending upon the stage this process had reached at the time of observation. This clinical and pathological entity is characterized by a peculiar, progressive, diffuse fibrosis of the pulmonary alveolar walls, leading to deficient aeration of the blood, with resulting dyspnea and cyanosis, and to enlargement and eventual failure of the right side of the heart. The etiology of the condition is at present undetermined.

Idiopathic Spontaneous Pneumothorax. S. H. Babington. *West. J. Surg.* 52: 73-76, February 1944.

A statistical study is presented of 44 cases of so-called idiopathic spontaneous pneumothorax; 31 were found in recent medical literature and 13 new cases are added. Collection of data was difficult because of incompleteness of many of the case histories. [Actually not all the cases in the combined series were entirely spontaneous, and in some the associated lesions were such as to make the use of the term "idiopathic" questionable.—L. M. J. F.]

Fifty-two per cent of the cases occurred in the third decade; 86.5 per cent were in males. The great majority gave no history of occupational strain. The left lung was affected in 24 instances, the right in 18. The history was negative for chest accidents or afflictions in 65 per cent, but this figure includes 11 cases in which no statement on that point was obtainable. Eleven (25 per cent) patients had symptoms ranging from a few days to two months preceding the attack.

Pain was absent in 8 cases; it occurred in the remaining 36 in varying degree. Cough was mentioned in only 3 cases. Five patients had primarily abdominal symptoms, in 1 case leading to a diagnosis of perforated peptic ulcer. The most common symptom after pain was dyspnea, which occurred in 26 patients. Many of the patients were quiet at the time of the attack, while others were under moderate strain.

On physical examination, 3 patients were in shock, 3 showed cyanosis, and 4 had fever. Sixteen had an increased white blood cell count—from 10,000 to 36,900—with a relative polynucleosis in 8.

The x-ray findings may be enumerated as follows: adhesions in 8 patients; pulmonary bullae in 5; pneumonic process in 1; fluid (one bloody) in 10; mediastinal displacement in 12; complete lung collapse in 2.

Treatment consisted for the most part in rest and sedation. Several patients required thoracoscopy to sever adhesions, aspiration of air and fluid, and transfusion. Twenty-three per cent had repeated attacks. One patient was brought in dead. All of the rest eventually recovered. LESTER M. J. FREEDMAN, M.D.

An Occupational Disease of Electric Welders. T. R. Jones and Jessie A. Lockhart. *Texas State J. Med.* 39: 532-534, February 1944.

Electric welding is ordinarily done with rods composed of approximately the same alloy as the material being welded, with a covering containing silicon and asbestos, the purpose of which is to furnish a protective screen of gases about the welding surface. The fumes produced during the process contain ozone, nitrogen oxides, silicon, asbestos, iron, and metallic oxides characteristic of the alloy being welded.

Experimental animals forced to breathe concentrated welding fumes with the iron particles filtered out died of pulmonary edema. Ozone and nitrogen oxides are recognized as the basic cause, with the nitrogen oxides probably being the chief offenders. In man welding fumes may produce acute or chronic pulmonary changes.

The acute changes produced by heavy concentrated exposure consist of pulmonary edema complicated by bronchial ulceration and pneumonia. With continued exposure this progresses to an acute bronchitis characterized by severe cough, profuse expectoration of blood-tinged sputum, fever, loss of weight, malaise, and inability to work.

Chronic changes, developing after repeated exposure, consist of chronic bronchitis, pulmonary fibrosis, asthmatic wheezing, and eventually pulmonary emphysema.

With adequate ventilation, men may work as electric welders for periods of ten to twenty-five years and remain in good health. In many such workers, however, x-ray examination reveals a fine mottling scattered throughout both lung fields, shown at autopsy to be due to deposits of iron particles less than 0.5 micron in diameter.

The authors briefly report 6 cases of acute pulmonary conditions following heavy exposure to electric welding fumes in poorly ventilated, confined spaces. Three of the patients had pulmonary edema; 1 of these, along with the pulmonary changes, had a "metal fume fever" due to zinc oxide from welding galvanized iron pipe. The remaining 3 patients were men with apparently healed tuberculosis. In these, moderate to severe pulmonary hemorrhages followed six, eight, and ten weeks' exposure, respectively, but no subsequent spread of the tuberculosis was demonstrated. All cases improved promptly following cessation of exposure, which is the only effective treatment.

E. W. GODFREY, M.D.

Further Observations on Lung Changes in Electric Arc Welders. O. A. Sander. *J. Indust. Hyg. & Toxicol.* 26: 79-85, March 1944.

It has become quite generally recognized that both acute and chronic lung changes may occur when welders

are exposed to highly concentrated fumes. It is the chronic changes which are considered here. As seen on chest roentgenograms, these consist of discrete nodular shadows uniformly distributed throughout both lungs, resembling somewhat the appearance of classical silicosis. The borders of these round shadows are generally more sharply defined, however, than are silicotic nodules, and the hilum shadows are less prominent. Histologic sections from a case coming to autopsy showed deposits of iron pigment in the lymphatics surrounding the blood vessels. The iron appeared to excite no reaction and evidence of fibrous tissue proliferation was entirely lacking. It has been concluded that these iron collections are responsible for the nodule-like shadows seen on x-ray films.

The finding of nodular shadows on chest roentgenograms of electric welders has been frequently reported since the author's previous communication (Enzer and Sander: *J. Indust. Hyg. & Toxicol.* 20: 333, 1938). Among 256 welders, Britton and Walsh found 24 with pseudo-nodulation (*J. Indust. Hyg. & Toxicol.* 22:125, 1940). The author reviewed 500 welders' films and found an incidence of nodular shadows of less than 5 per cent. This was at first attributed to the fact that very few industries in the district from which these films were obtained required *confined* welding. Recently, however, pulmonary changes have been discovered in welders whose work was not at all confined except for canvas partitions between groups of workers. In this group, 54 of the first 80 welders examined roentgenographically showed definite small nodular shadows. This could be explained only on the basis of excessive fume production and improperly placed ventilation.

Five cases are reported and roentgenograms for each are reproduced.

The following conclusions are drawn: (1) Electric arc welding which is done in large rooms and where the fumes are not allowed to concentrate excessively near the breathing level does not cause any lung changes even after many years of work. (2) Excessive inhalation of concentrated fumes, especially in confined and unventilated spaces, may cause siderosis in the lungs in from six to ten years. The siderosis so produced consists only of inert iron pigment deposits in the lymphatics, without fibrous tissue proliferation and without progressive changes after exposure is materially decreased. (3) Electric welding and siderosis do not predispose to tuberculosis or other lung infections. (4) Siderosis of welding causes no functional impairment of the lungs and, therefore, no symptoms referable to the lungs. (5) Acute irritative phenomena of the throat may occur with too prolonged confined work in dense clouds of fumes, but these appear to be transitory reactions leaving no residual impairment. (6) Respiratory involvement may be prevented in welding, even with the most confined and prolonged work, if proper precautions are taken, either by adequate exhaust ventilation, ventilated helmets, or positive pressure respirators.

The authors prefer to designate these cases as "siderosis of welding," but this does not imply the presence of fibrous tissue proliferation.

Miliary Densities Associated with Mitral Stenosis. Allan Hurst, Sydney Bassin, and Ida Levine. *Am. Rev. Tuberc.* 49: 276-285, March 1944.

Disseminated miliary densities in the lungs may occur in association with rheumatic mitral heart disease

and are readily confused with other miliary processes, such as tuberculosis, sarcoid, pneumoconiosis, and lymphangitic carcinomatosis. Five cases observed by the authors are reported, with illustrative roentgenograms.

The cause of these miliary or submiliary densities has been in some dispute. Thus, they have been ascribed to the formation of hemosiderin pigment deposits and surrounding tissue reaction, to engorged blood vessels "caught on end," and to engorged perivascular lymphatics due to pressure on the main lymphatic trunks by the enlarged heart.

In one of the cases described the lungs were studded from apex to base with soft fluffy densities. These were thought to represent engorged blood vessels "caught on end," a condition which is usually transient in character. In the second case there was a marked vascular engorgement throughout the lung fields arranged in a linear pattern, and observation over a period of ten months showed no variation in the roentgenograms. Another case showed a combination of linear and nodular mottling and, in addition, in the periphery of the lower lung field, some larger dense nodules. These were assumed to consist of local areas of perivascular fibrosis with deposition of hemosiderin pigment from the extravasation of blood. The authors believe that in the first two instances the x-ray changes were the result of simple vascular dilatation, either of transient or permanent nature. The other cases, showing larger and firmer nodules and dense linear shadows or bands, are considered to be altogether permanent and appeared to be progressive.

L. W. PAUL, M.D.

Intrathoracic Tumors as a Problem in Diagnosis. Raymond J. Harrington. *J. Iowa M. Soc.* 34: 45-50, February 1944.

Accurate diagnosis of intrathoracic tumors is of considerable clinical importance since the advent of improved technic in surgical approach. The mortality rate of pneumonectomy has decreased from 63 per cent to 10 per cent and there are numerous reports of five- to nine-year cures of bronchiogenic carcinoma.

The most frequent intrathoracic tumor is the metastatic lesion. Solitary pulmonary metastases are difficult to differentiate from primary tumors, and their diagnosis must be based on a thorough search for a primary source. Metastases are usually situated in the lower lung fields and are multiple.

In general, the primary intrathoracic tumors may be classified as originating from the mediastinum, lungs, or from certain elements of the chest wall. The most common tumor in the primary group is bronchiogenic carcinoma. Squamous-cell and mixed or small-cell carcinomas comprise 70 to 90 per cent of this group. These tumors occur chiefly near the hilus, since they usually arise from the larger bronchi. They are considered more amenable to treatment than the less common adenocarcinoma because of the possibility of early diagnosis due to encroachment of the tumor on the bronchial lumen with resultant symptoms—early cough, hemoptysis, and dyspnea. Frequent chest roentgenograms and repeated bronchoscopic examinations are essential for an early diagnosis. Adenocarcinoma of the lung usually arises from the smaller bronchi near the periphery. It gives few signs and symptoms early in its course and at this stage is usually found by accident. It tends to invade the pleura, ribs,

or cervical plexus and to metastasize *via* the blood stream, frequently to the brain.

Bronchial adenoma usually occurs in the larger bronchi and has a greater tendency to bleed than carcinoma. The clinical features and roentgen findings are indistinguishable from carcinoma, being those of bronchial obstruction with ensuing emphysema, atelectasis, and infection. Bronchoscopic examination and biopsy ordinarily determine the diagnosis.

The relative position and the character of the roentgen shadow aid in differentiating the numerous, although uncommon, mediastinal tumors. Experience shows that solitary, clearly defined, and circumscribed lesions are usually benign, while the malignant tumors produce diffuse, poorly defined, irregular shadows. This rule is not absolute, however, since a benign lesion may contain areas of malignant change or a well defined shadow may be due to a mediastinal abscess or non-pulsating aneurysm. Localization of mediastinal tumors may be deduced from the symptoms and signs produced by pressure and invasion of neighboring structures. There may be local or referred pain, dyspnea, cyanosis, venous dilatation, cough with or without expectoration, hemoptysis, Horner's syndrome, dysphagia, hoarseness, and paralysis of the diaphragm. Diagnostic pneumothorax, special studies of the sternum and spine, and esophagrams may be necessary in addition to the routine fluoroscopic and roentgen examination of the chest.

Primary tumors of the mediastinum are rare, the most common being the dermoid cyst or teratoid tumor. These lesions usually occur in young adults, are sharply defined, arise in the anterior mediastinum, and may become very large with practically no symptoms. Overpenetrated films may show incompletely formed teeth or bone or other calcification within the shadow. The ganglioneuromas, neurofibromas, and perineural fibrosarcomas are rounded lesions situated in the posterior mediastinal gutter and are considered potentially malignant. Those originating from the spinal or sympathetic nerves may be hour-glass in form and involve the spinal canal, producing referred back pain and even paralysis. Cystic tumors may arise from the respiratory epithelium or pericardium. Chondromas and osteochondromas may spring from the costochondral junctions, invading the anterior mediastinum, or from the costovertebral structures, growing into the posterior mediastinum.

Lymphoblastoma involving the mediastinal nodes produces a sharp, lobulated or nodular, bilateral but asymmetrical shadow having equal density with that of the heart. It is most difficult to differentiate the type of lymphoblastoma by x-ray but lymphosarcoma is believed to have a tendency to be unilateral.

A definite clinical diagnosis of thymic tumors is difficult during life, the usual course being less than six months after the onset of symptoms. Lymphosarcoma and thymoma are the most common forms. Tumors of the thymus gland usually occupy the anterior mediastinum and compress the trachea and great vessels.

Substernal tumors of the thyroid gland are rarely completely intrathoracic. They can be recognized by their upward movement on swallowing and by compression or displacement of the trachea and other surrounding structures.

Aortic aneurysm, innominate aneurysm, and right-sided aortic arch are mentioned because of possible confusion with neoplasms. The one constant diagnostic feature is the inability to separate the mass from the

vessel shadow by any degree of rotation of the patient. Other variable aids are erosion defects in the sternum or vertebrae, calcifications continuous with those in the aorta, pulsation, esophageal displacement, and serologic evidence of syphilis.

The following tumors can be removed surgically with success: teratomas, dermoid and other cysts, intrathoracic goiters, benign connective-tissue tumors including those arising from cartilage, benign neurogenic tumors, benign thymic growths, and certain primary sarcomas. The primary malignant tumors of the mediastinal lymph nodes and malignant thymomas are best treated by radiation therapy.

Ten case histories are presented accompanied by roentgen illustrations. Three of the 6 cases of bronchiogenic carcinoma revealed fairly well circumscribed pulmonary masses; the remaining 3 showed x-ray evidence of bronchial obstruction and atelectasis. Two cases of mediastinal tumor are included, a lymphosarcoma and benign cyst. One case resembling bronchiogenic carcinoma clinically proved to be a non-specific pneumonitis. The tenth case was a large asymptomatic aneurysm.

LESTER M. J. FREEDMAN, M.D.

Huge Intrathoracic Fibroma: Report of a Case. O. Theron Clagett and Paul F. Hausmann. *J. Thoracic Surg.* 13: 6-15, February 1944.

Intrathoracic fibroma is an extremely rare tumor. The authors present a case report of what they believe is the largest neoplasm of this type ever successfully removed. The point of origin could not be established, as the mass was densely adherent to the mediastinum and chest wall. The tumor on removal weighed 4,972 gm. The patient was a male forty-four years old who complained chiefly of progressive dyspnea for two years. Roentgenograms showed a mass occupying the entire right chest from the second rib anteriorly down to the diaphragm.

Although histologically benign, these tumors may become malignant clinically because of the size which they attain. It is suggested that routine roentgenograms of the chest of every person would enable earlier diagnosis of silent tumors, when they could be more easily removed. A classification of benign intrathoracic growths is presented.

HAROLD O. PETERSON, M.D.

Adenoma of the Trachea and the Bronchus. Leo Schwartz. *Arch. Otolaryng.* 39: 231-242, March 1944.

The term "adenoma" as applied to endobronchial neoplasms embraces a large group of tumors which have been described as benign adenoma, polypoid adenoma, adenomatous polyp, adenoma of the bronchial mucous glands, carcinoid, benign epithelial tumor, benign glandular tumor, adenocarcinoma of low-grade malignancy, "tumor-like formation of inflammatory hyperplasia," endothelioma, mixed tumor, etc.

Bronchial adenoma may be pedunculated or may have a sessile base. The tumor with the thin pedicle, as a rule, grows entirely within the bronchial lumen. The intramural type presents a flat base and grows between the cartilaginous rings, elevating the mucosa inwardly and the fibrous membrane outwardly but remaining encapsulated within this limiting membrane. The endo-extrabronchial type has the configuration of a dumbbell, the smaller portion presenting endobronchially and the larger extrabronchially.

The signs and symptoms of bronchial adenoma are those characteristic of bronchial obstruction and depend on the location of the tumor, the type of obstruction produced, the amount of tributary alveolar tissue obstructed, and other factors, such as the type and virulence of secondary infection. Cough and profuse hemoptysis are the two most frequent and constant signs. On roentgen examination obstructive atelectasis is manifested by diminution in the alveolar capacity on the involved side of the thorax and elevation of the diaphragm on the same side. The ribs are arranged in a plane that is more vertical than the normal. The intercostal spaces are narrowed. The tracheal, mediastinal, and cardiac shadows are displaced toward the atelectatic side. The atelectatic lung often appears clouded as a result of pneumonitis or "drowned lung."

Obstructive emphysema is manifested by displacement of the heart and mediastinum toward the contralateral side or the side opposite to the obstruction. A roentgenogram taken on full inspiration will show full and equal expansion on the two sides; on full expiration, however, the abnormally ballooned obstructed lung fails to contract as does the normal unobstructed lung. The roentgen shadows of the heart, the trachea, and mediastinum are normally placed on inspiration; on expiration, however, these organs are forcibly pushed by the overexpanded lung into the opposite cavity. The intercostal spaces on the emphysematous side are widened as compared with those on the normal side, and the ribs assume a plane more horizontal than normal.

Bronchial adenoma is most frequently confused with bronchiogenic carcinoma. Adenoma is, however, overwhelmingly a disease of young women, while carcinoma occurs chiefly in old men. Hemoptyses occurring with adenoma are inclined to be more profuse than those with carcinoma. Adenoma does not metastasize nor does it infiltrate surrounding tissue, though it does recur and encroach on the adjacent lung. Frequently bronchoscopy alone can produce the correct diagnosis.

It seems likely that the tumors that arise from stalk-like bases and have neither mural nor extrabronchial extensions can be entirely cured by bronchoscopic means. This applies to the growth alone and not to pathologic states of the lung distal to the growth, which may demand more drastic treatment. Tumors which show mural and extramural extension and all cases complicated with irreparable pulmonary damage as a result of prolonged obstruction demand surgical intervention, with thorough eradication of diseased pulmonary tissue. Radium and roentgen therapy have proved entirely ineffectual in both the eradication and the retardation of growth of these tumors.

Three cases of adenoma of the tracheobronchial tree are reported. In 2 the tumor was in the bronchus; in the third case, in the extreme upper portion of the trachea.

Mediastinal Ganglioneuroma. Howard K. Gray, Duncan V. Shepard, and Malcolm B. Dockerty. *Arch. Surg.* 48: 208-213, March 1944.

Ganglioneuroma is a rare tumor of the posterior mediastinum, but in the last twenty-five years the increasing frequency of thoracotomy has led to an increase in the number of cases so diagnosed. The clinical picture is vague and symptoms may be absent, the discovery being accidental. Pressure symptoms

are the most common; there is occasionally a Horner's syndrome or a Pei-Ebstein type of fever. Roentgenologically the tumor appears as a smooth, homogeneous, ovoid shadow arising in the posterior thorax. No invasion of contiguous structures is seen, although invasion of the ribs and vertebrae may be present; pressure erosion may be demonstrated. Accurate preoperative pathological diagnosis is seldom made.

Treatment is surgical; irradiation is ineffective. While complete excision is desirable, the local adhesions of the tumor may make this impossible. The nearness of important vascular and nerve structures renders this the more difficult. Hemorrhage and infection are the two most dangerous complications of operation.

Grossly the tumor resembles a uterine fibroid. Microscopically, it consists of compact fusiform cells with round or oval, small, deeply staining nuclei. Islands of ganglion cells surrounded by satellite cells are scattered through the tumor. Nerve fibers are present, mostly non-medullated and arranged in bundles. Three cases are reported.

LEWIS G. JACOBS, M.D.

Mediastinal Lipoma. Case Report. William L. Watson and Jerome A. Urban. *J. Thoracic Surg.* 13: 16-29, February 1944.

Intrathoracic lipomas usually arise in the mediastinum and are often considered congenital in origin. Up to 1941, 36 cases had been reported. Surgical removal is advocated even though the tumor is asymptomatic when diagnosed. There are three types, depending on location. In the first group are those limited to the thoracic cavity. The second group comprises those which extend into the neck, and in the third group are tumors of the "dumbbell" type, projecting through an intercostal space.

In one reported case a tumor was seen postmortem weighing 17 lb. 6 oz. In the case recorded here the tumor weighed 6.8 lb. and is the largest intrathoracic lipoma successfully removed. The patient was a woman forty years of age who had experienced some dyspnea on exertion all her life. This had become much more severe in the last year, with associated retrosternal pain, epigastric pain, dysphagia, nausea, and vomiting. Roentgenograms of the chest showed a tumor filling the entire left side except the apex above the first rib anteriorly. Visualization of the heart chambers was accomplished with 70 per cent diodrast. This showed no pulmonary circulation on the left side. The preoperative diagnosis was established by an aspiration biopsy. Postoperative roentgenograms show a progressive shift of the mediastinum into the left chest and the completely collapsed left lung never became aerated. A detailed account of the operation and postoperative course is presented.

HAROLD O. PETERSON, M.D.

Hemangioma of the Mediastinum: Report of a Case. W. E. Adams and R. G. Bloch. *Arch. Surg.* 48: 126-129, February 1944.

Roentgen examination of a man 34 years old in the course of a health check-up showed an oval opacity occupying most of the left lung field. He gave a history of having a tumor removed from the base of the neck, on the left side, at the age of 18 months and again at 10 years. Examination now showed a firm mass in this region and signs of consolidation in the left chest. A

biopsy of the neck tumor led to a diagnosis of hemangioma with a dense fibrous stroma. The left bronchial tree was visualized with the aid of iodized oil, and found to be displaced posteriorly by a mass occupying the anterior half of the upper two-thirds of the chest. Pneumothorax demonstrated a few adhesions between the tumor and the diaphragm.

The larger part of the tumor was removed *via* the left pleural cavity, with a small piece of adherent pericardium; a small amount had to be left behind the clavicle. The postoperative course was rather stormy because of vasomotor instability and an attack of auricular flutter on the third day, but this responded to digitalization. A wound infection developed, necessitating removal of some small pieces of devitalized cartilage. The patient was discharged in six and a half weeks and has remained well for four years, except for a left vocal cord paralysis which developed postoperatively and has persisted. Microscopic examination of the tumor showed it to be a benign cavernous hemangioma with two areas of bone containing marrow.

LEWIS G. JACOBS, M.D.

Sarcoidosis of the Heart: Report of a Case and Review of the Literature. John B. Johnson and Robert S. Jason. *Am. Heart J.* 27: 246-258, February 1944.

A case of generalized sarcoidosis is described in which massive infiltration of the myocardium was responsible for serious symptoms and caused the death of the patient, a male negro aged 24. A roentgenogram of the chest revealed enlarged mediastinal nodes with pulmonary infiltration and an enlarged heart. The post-mortem findings are described in detail.

Eight cases of sarcoidosis of the heart were found in a review of the literature. Clinical evidence of heart disease was present in 3 of these, and sudden death occurred in another. The electrocardiogram showed no characteristic changes but in several of the cases of massive involvement there were pronounced abnormalities of the cardiac mechanism. The author believes that some cases recorded as atypical tuberculosis, specific myocarditis, granulomatous myocarditis, and myocarditis of unknown cause may in fact have been sarcoidosis of the heart. HENRY K. TAYLOR, M.D.

Atypical Coarctation of the Aorta, with Absence of the Left Radial Pulse. A. Grishman, M. L. Sussman, and M. F. Steinberg. *Am. Heart J.* 27: 217-224, February 1944.

Coarctation consists of a narrowing, stenosis, or complete atresia of the isthmus of the aorta, usually beyond the origin of the subclavian artery and involving its orifice, but sometimes situated proximal to its origin. The wall is usually involved to an extent of 1 to 3 inches, or even more. Three cases with atypical symptoms are presented. In contrast to typical coarctation, there was no discrepancy between the blood pressures in the lower and upper extremities in these cases, no diminution of the femoral pulsations, and no retardation of the pulse wave in the lower extremities. Angiocardigraphic studies verified the diagnoses.

Each of the 3 cases showed anatomically a relatively extensive involvement of the aorta at the isthmus and the distal portion of the arch, causing a slight narrowing. However, there was no obstruction to the blood flow in the thoracic aorta. This explains the fact that the relationship of the blood pressure in the lower to

that in the upper extremities was normal, and that the pulse wave in the femoral artery was not retarded. However, in all three cases the orifice of the left subclavian artery was obstructed, resulting in almost complete absence of the left radial pulse. The origin of the left common carotid artery presumably, also, was narrowed, for there was a stenotic pulse, as well as a systolic murmur and thrill. In one case even the orifice in the innominate artery seemed to be involved. The aorta in another case was hypoplastic beyond the isthmus; the same patient also showed collateral circulation. Hypertension was present in two instances. Erosion of the ribs was not observed.

HENRY K. TAYLOR, M.D.

THE DIGESTIVE SYSTEM

Effect of Water Taken with Meals on Gastric Emptying. Edward J. Van Liere and David W. Northup. *Gastroenterology* 2: 195-200, March 1944.

To determine the effect, if any, of drinking large quantities of water on gastric emptying, 21 normal medical students were given a test meal consisting of 15 grams of Quaker Farina, boiled in water down to a volume of 200 c.c. Fifty grams of barium sulfate were added so the position of the meal could be determined fluoroscopically. Several determinations of the normal gastric emptying time were made on each individual.

Nine subjects ate the test meal and drank 500 c.c. of tap water with it. It was found that the ingestion of this amount of water had no appreciable effect on the gastric emptying time.

Twelve subjects drank 1,000 c.c. of water with the test meal. The gastric emptying time of 11 of the subjects was not affected by drinking this quantity of water. One subject, however, showed a statistically significant decrease in gastric emptying time.

It was concluded that relatively large quantities of water taken with meals have no effect on gastric emptying time in the average subject, but an occasional individual may show some effect.

Gastric Fibrosis Involving the Duodenum. Daniel N. Silverman and Louis L. Friedman. *Gastroenterology* 2: 186-190, March 1944.

A 40-year-old male complained of intermittent pain in the epigastric area during the past fourteen years, with a loss of 20 pounds in weight in that time. The pain was either gnawing or sharp and on occasion would radiate to the infrascapular area bilaterally and to the mid-line on the same level. It was so severe at times that the patient was unable to work or sleep; at other times there were complete remissions of all symptoms and the patient would enjoy a comparatively normal life. These periods of complete remission and exacerbation of symptoms varied greatly in length. Ingestion of any type of food during the attacks relieved the symptoms for about an hour, and the pain would then recur with greater intensity. The patient's appetite was good but he suffered from pyrosis, nausea, and occasional vomiting. There was never any hematemesis. Deep palpation in the epigastric area elicited severe pain. The abdominal musculature was spastic and relaxation could not be obtained. No abnormal masses were palpable. With the exception of a moderate hyperacidity, laboratory examinations were within normal limits.

Gastro-intestinal examination showed what appeared to be a benign polyp, about 2.5 cm. in diameter, in the antrum of the stomach adjacent to the pylorus, and a similar but larger and more irregular filling defect in the first portion of the duodenum, the walls of which were extrinsically smooth and well rounded. At six hours there was a 60 to 70 per cent gastric retention of the barium meal. Further fluoroscopic and x-ray examinations revealed a spastic type of colon. On gastroscopy the gastric mucosa was found to be normal with the exception of a small area on the anterior surface near the lesser curvature of the stomach, in the antral region adjacent to the pylorus. Here were multiple areas which gave the impression of being petechiae or minute superficial ulcers. The filling defect seen on x-ray examination appeared as a flat elevated submucosal tumor without any bridging of the mucosal folds.

A gastrojejunostomy was performed without difficulty. A stellate scar was found on the anterior surface of the duodenum; this was thought to be the site of an old ulcer. The duodenum was fixed by adhesions and could not be freed for removal. The wall of the duodenum appeared normal. The lesser curvature of the stomach on the anterior aspect near the pylorus felt thickened and fibrotic. The stomach was divided at the upper and middle thirds and resected. On gross examination the stomach wall was soft, with the exception of a small area in the antrum which sectioned with increasing resistance and was slightly firmer than the surrounding tissues. Microscopic examination showed an extensive fibrosis of the submucosa which extended between the muscle bundles and up to and including the subserosal area of the stomach.

The patient made an uneventful recovery and is now free of symptoms.

A small area of connective-tissue proliferation in the stomach, especially with extension into the duodenum, is rarely observed. The process is usually considered to be malignant, but serial sections through the entire segment of the stomach failed to reveal any malignant cells in this case.

X-Ray Appearances in Amoebic Hepatitis. J. Munk. *Brit. J. Radiol.* 17: 48-53, February 1944.

Some cases of amoebic hepatitis will show no evidence on roentgen examination. Occasionally gas may be identified in an abscess cavity and sometimes calcification may be observed in chronic cases. The signs commonly seen are indirect ones, as elevation or irregular bulging of the diaphragm, frequently with diminished motion and sometimes paradoxical motion. Pleurisy is sometimes seen, and there may be a zone of atelectasis just above the diaphragm.

These signs alone are not useful in the differential diagnosis, as many other conditions will produce them. When interpreted in the light of the clinical findings, they are helpful in confirming the diagnosis.

Ten cases are briefly reported with the roentgen findings. Roentgenograms are reproduced.

SYDNEY J. HAWLEY, M.D.

Radiological Anatomy of the Normal Terminal Choledochus. M. Royer and A. V. Solari. *Gastroenterology* 2: 189-185, March 1944.

Two methods were employed by the authors in studying the radiological anatomy of the normal choledochus,

—one, examination of autopsy specimens; the other, non-surgical cholangiography. Twenty-eight autopsy specimens—all normal—were studied radiologically by means of barium sulfate, three roentgenograms being made of each specimen, with 30, 50, and 80 cm. of water pressure. Non-surgical cholangiography, consisting of peritoneoscopy and injection into the gallbladder of an iodinated substance, under direct observation, was carried out in 15 cases.

Study of the terminal choledochus by these two methods showed it to have a characteristic appearance similar to the mouth-piece of a flute. This knowledge "is useful in distinguishing the normal from pathologic conditions of the terminal choledochus and diverticula of the second portion of the duodenum. A dilatation of the terminal choledochus (ampulla of Vater) was observed only rarely in the roentgenograms."

Polyposis of the Gallbladder: Case Report. J. Gregory Grego and Henry N. Harkins. *Am. J. Surg.* 63: 398-401, March 1944.

A case of polyposis of the gallbladder is reported for three reasons: (1) its rarity; (2) its prophylactic importance, because of a possible predisposition of polypoid growths to carcinoma; (3) its interest, because of the preoperative roentgen diagnosis.

A 52-year-old female complained of bleeding from the rectum, weight loss, and abdominal distress. Examination revealed multiple polypoid growths in the rectal canal. On cholecystography the gallbladder shadow was clearly seen in the twelve- and sixteen-hour examination. A number of small negative shadows of sharp outline were present, somewhat different from the usual negative shadows due to gallstones, suggesting the possibility of polyps of the gallbladder. The rectal polyps were removed and the patient was discharged. There was no more rectal bleeding, but the abdominal distress continued. On readmission to the hospital cholecystectomy was done, and polyps of the gallbladder were found. No other pathological or surgical evidence of disease was discovered and the patient was subsequently free from symptoms.

The authors cite Kirklin's reports (*Am. J. Roentgenol.* 25: 46, 1931 and 29: 8, 1933) from the Mayo Clinic, where 8.5 per cent of more than 17,000 gallbladders surgically removed showed papillomas. Kirklin was able to make a correct roentgen diagnosis in many of these cases.

Malignant changes have been found associated with polyposis of the gallbladder but the etiologic association of carcinoma with papilloma has not been proved. Papillomas occur in the fundus and may give rise to symptoms of cholecystic disease.

G. A. CREEL, M.D.

Pancreatic Calculi: Report of Seven Cases in Two of Which Cure Was Effected by Pancreaticolithotomy. Joseph Lionello, Bernard J. Ficarra, and Nicholas H. Ryan. *Arch. Surg.* 48: 137-143, February 1944.

The cause of pancreatic calculi is unknown but seems to be related to the stagnation of pancreatic secretions, resulting from inflammation and sclerosis. The stones are classified as true (in the ducts) and false (calcifications in the parenchyma). True calculi are usually smooth and rounded, rarely faceted; they vary in size and are usually found in the head of the organ. They are accompanied by a chronic interlobular pancreatitis.

and fibrosis. Cysts or abscesses may form, and secondary changes in the liver and biliary tract, duodenal ulcer, or atheroma of the splenic artery may be associated.

The clinical picture is vague. Epigastric pain is the most prominent symptom, and loss of weight, diarrhea, a sense of epigastric pressure, and lowered blood pressure are sometimes present. The picture of a painful diabetes should suggest this condition.

The diagnosis is made by the roentgenogram; the stones are typically opaque and lie across the upper abdomen at the level of the second and third lumbar vertebrae. The condition is rare, only 232 cases having been recorded. Surgical removal of the stones is imperative to prevent further secondary changes. Two cases successfully operated upon and 5 diagnosed roentgenographically are reported.

LEWIS G. JACONS, M.D.

THE SPLEEN

Calcification of the Spleen. Edwin F. Gray. *Am. J. Roentgenol.* 51: 336-351, March 1944.

A group of 111 spleens from unselected necropsies were subjected to roentgen examination. Evidence of calcification was found in 63 of these. Most of the cases occurred in the fifth, sixth, and seventh decades. In 8 cases there was an active systemic tuberculosis, while many others disclosed evidence of apical scars or thickening of the apical pleura, possibly due to healed tuberculosis. Multiple calcifications of the so-called miliary type occurred in 58 cases. The lesions varied in size from 1 mm. to almost 1 cm. in diameter. Some were gelatinous and some extremely hard in consistency. On microscopic examination, the peripheral portion of the lesion is found actually to be a capsule of concentrically arranged hyalinized fibers. No iron pigment was present. No thrombosed vessels were associated with these lesions. No tubercle bacilli were found. Serial sections frequently disclosed bone formation in the core. The splenic pulp about the lesions was not distorted to any great extent.

There were 5 instances of calcium deposition within the capsule. Here the calcification was seen as a thin layer composed of granular deposits of calcium density distributed in a linear manner. No bone formation was noted.

Calcification occurred within an infarct in one case. The roentgenogram showed four triangular areas of calcification. There was no bone formation.

Calcification of the splenic artery was found in 5 cases. Roentgenograms showed circular or mottled shadows of calcium density in the course of the artery. These occurred in the hilum or in vessels within the splenic pulp near the hilum.

Gross and microdissection of calcified lesions furnished no direct evidence of a tuberculous or thrombotic origin. The multiplicity of the lesions is in favor of miliary tuberculosis as the etiologic factor, as is the presence of similar lesions in the liver. Guinea-pig inoculation was performed in 2 cases, however, and after eight weeks there was no evidence of tuberculosis.

Calcifications of infarcts, the capsule, and splenic artery usually occur in patients of advanced age.

The author gives a review of the literature on calcifications of the spleen, with a full bibliography, and three illustrative case reports.

CLARENCE E. WEAVER, M.D.

THE DIAPHRAGM

Roentgen Diagnosis of Some of the Lesions Adjacent to and Involving the Diaphragm. Eugene P. Pendergrass. *Pennsylvania M. J.* 47: 587-590, March 1944.

Next to a good history, the roentgen examination is probably the most valuable single procedure in the diagnosis of lesions in and around the diaphragm. The examination should include fluoroscopy in the erect position if possible and roentgenography of the chest and upper abdomen in the erect position, as air and fluid levels are sometimes the only clue to the diagnosis. Films should also be made in the horizontal position to demonstrate the soft-tissue outlines of the kidneys, liver, spleen, and muscles.

Barium may be used to outline a hernia of the diaphragm when the stomach or colon is found in the thorax. Pneumothorax and pneumoperitoneum may at times be used; in the latter procedure the danger and pain will be obviated if CO₂ is used instead of air. Hepatosplenography with thorotrast (75 c.c. intravenously) will produce dense shadows on the roentgenogram, representing the liver and spleen. Abscesses and metastatic lesions do not cast shadows and may be demonstrated in this manner.

The dome of the right diaphragm is usually about 1.5 cm. higher than the left dome; the domes are usually smooth in outline and irregularity in their contours may be due to adhesions or variation in attachment or size of the constituent muscle bundles. Occasionally one finds a rounded lump on the mesial aspect of the dome of the right diaphragm. This may be due to a weakness of the diaphragm, or the inferior vena cava may prevent its downward excursion. Tumors of the liver and subphrenic lesions will give a similar appearance.

An anomalous enlargement of the right lobe of the liver will produce a shadow in the lateral view that may simulate that of an interlobar collection. The posterior costophrenic sulcus is much lower than the anterior and fairly large localized collections may escape detection unless the patient is examined in the lateral position. A slight restriction in the movement of the diaphragm should, if possible, be studied in the erect position, as the domes of the diaphragm are higher and the excursion is greater when the patient is in the horizontal position. This is particularly true in infants and young children.

Diaphragmatic elevation, either bilateral or unilateral, may be found after an abdominal operation and may have no pathological significance. Paradoxical movement of a diaphragm is now commonly seen due to the frequency of phrenic operations.

Kidney and perinephric lesions which cause localized elevations of the diaphragm are best seen in the lateral view. Tumors are not likely to cause fixation of structures; inflammatory lesions often do and may produce an elevation of both domes of the diaphragm. Unless one employs thorotrast or pneumoperitoneum for demonstration of the liver, the roentgenographic impression of its size may be deceiving.

Calcification in the liver is, in the experience of the author, caused most frequently by a primary tumor or echinococcus cysts. The latter are usually multiple.

Small dense spots frequently seen in the spleen may be due to phleboliths, calcified tubercles, fungus infections, or primary tumors.

Soft-tissue outlines are obscured in ascites, and loss

of the psoas outline may be due to an inflammatory or a malignant lesion.

JOSEPH T. DANZER, M.D.

THE SKELETAL SYSTEM

Congenital Absence of the Patellae Associated with Arthrodysplasia of the Elbows and Dystrophy of the Nails: A Hereditary Syndrome. Hyman R. Senturia and Ben D. Senturia. *Am. J. Roentgenol.* 51: 352-358, March 1944.

After reviewing the literature on the hereditary syndrome described in the title the authors state that, although there has been some variation in the nature and degree of the congenital defects which have been described, the localization of the abnormalities to the nails, particularly of the thumbs, to the patellae, and to the elbows has been fairly striking.

The typical dystrophic nail presents a small normal appearing base that is much thinner than normal and that gradually disappears about half way down the nail bed. Occasionally the nails of the toes are affected. The patella may be absent altogether or show at least severe hypoplasia. Roentgenograms of the elbow reveal an arthrodysplasia characterized by an elongation and deformity with luxation of the proximal end of the radius. The head of the radius is poorly formed.

A case is cited presenting the classical triad of deformities. The patient was a male, aged 36, whose great-great-grandfather was known to have had this affection. After three generations the condition reappeared, in the patient's mother, and 29 persons were affected in the three succeeding generations.

It is apparent from the literature on this subject that we are dealing with the hereditary transmission of a dominant character, not sex-linked, the anomaly being carried at the same time in two different systems, one derived from the mesoderm, the other from the ectoderm. Aschner (*J. A. M. A.* 102: 2017, 1934) concluded that the genes for the defect of the patella and the thumb nail are not only linked together in the same chromosome, but are even very near neighbors to each other within the chromosome. The gene for the luxation of the head of the radius is probably in the neighborhood of the other two genes, but not quite so close in the chromosome, as the whole syndrome does not occur so often as the association of the defect of the thumb nail and the patella.

A bibliography is appended.

CLARENCE E. WEAVER, M.D.

Arachnodactyly in Four Siblings, with Pneumoencephalographic Observations of Two. Harry D. Pasachoff, M. J. Madonick, and Carl Drayer. *Am. J. Dis. Child.* 67: 201-204, March 1944.

Arachnodactyly, or Marfan's disease, is characterized not only by the long, slender bones of the hands and feet, which give it its name, but also by muscle atrophy and laxity of ligaments permitting skeletal deformities and anomalies of the eye and heart. The commonly described deformities are kyphosis, scoliosis, funnel chest, high position of the patella, hammer toes, pes planus and subluxation of the joints. Ocular abnormalities include dislocation of the lenses, tremulous irises, myopia, miosis, shallow anterior chamber, and strabismus. Patent interventricular septum and patent ductus arteriosus are the more common cardiac findings. Dolichocephaly, enlargement of the ears,

and a melancholy expression may be present. Intelligence, as a rule, is good. Hereditary background is found in many instances. Roentgen examination shows the phalanges, metacarpals and metatarsals to be longer than is usual but reveals no abnormal changes in bone structure anywhere.

Two typical cases of this disease occurring in a brother and sister are described. Both children were retarded mentally. Encephalograms, believed to be the first recorded in the literature in this condition, showed moderately dilated lateral ventricles with no displacement. The remaining two children in the family were found to be similarly afflicted and information concerning the hereditary background revealed elements of the disease in the father and paternal grandfather. No cardiac anomalies were observed in any of the children.

LESTER M. J. FREEDMAN, M.D.

Case of Morvan's Type of Syringomyelia. Nathan Bloom and Lloyd J. Moss. *Virginia M. Monthly* 71: 131-133, March 1944.

The classical syndrome of Morvan's type of syringomyelia is seen in young persons and consists of initial pain about the shoulders and arms, followed by loss of pain and temperature sensation, with retention of the sense of touch and subsequent trophic changes of the bony structures. Painless indolent ulcers of the fingers and hands are common. Morvan's type of syringomyelia is less often seen than the various other forms.

The authors' patient was a 49-year-old colored woman with a history of a severe infection of the right hand six years before. Both hands and wrists increased in size, with gradually developing stiffness and flexion of the fingers of the right hand. Loss of sensation resulted in frequent burns and cuts, with slow healing. Numbness and tingling occurred in both upper extremities with occasional vague pains in the wrists or fingers. Some disability of the right hand was present on account of the flexion deformity, but there was no definite motor weakness or muscle twitching.

On admission, the hands and wrists were huge and deformed by swelling. The fingers were sausage-shaped and several indolent ulcers were present on the right hand, which was held in a flexed, stiffened state. Both wrists were unusually mobile and crepitant but were not tender or painful on motion. The biceps and triceps reflexes were absent. All other reflexes were normal and there were no pathological reflexes. The vibratory sense was intact throughout the body, and position sense was normal. Pain and temperature sensations were lost in both hands and wrists and were diminished above the wrist and on the trunk to the level of the twelfth dorsal segment. Below this segment, sensations were normal. The standard laboratory findings were essentially negative.

X-ray examination revealed a dorsal scoliosis with convexity to the right and slight lumbar scoliosis with rotation of vertebral bodies. The left third rib posteriorly was fractured. In the hands there was disorganization, with old fractures, of both wrists and a tendency toward "claw" hands, slight erosion of the terminal phalanges, and soft-tissue swelling. The patient received large doses of thiamin hydrochloride and deep x-ray therapy and seemed to improve.

The author points out that the joint changes described as "Charcot joints" may be due to direct

injury to the spinal cord, as in stab wounds, myelitis, spina bifida, and other cord lesions, and that such arthropathy is not always of syphilitic origin.

J. E. WHITELEATHER, M.D.

Pulmonary and Osseous Manifestations of Tuberous Sclerosis, with Some Remarks on Their Pathogenesis. Alfred J. Ackermann. *Am. J. Roentgenol.* 51: 315-325 March 1944.

According to our present conception, tuberous sclerosis is a form of congenital ectodermosis, as are three other outstanding entities, namely von Recklinghausen's neurofibromatosis, angiomas cerebri, and Hippel-Lindau's disease. In fully developed cases one finds most frequently the following symptoms: (1) epileptic seizures; (2) mental deficiency; (3) cutaneous lesions, and (4) congenital tumors of the eye and many visceral organs. Clinical manifestations of the disease are often recognizable in infancy. They depend upon the organs involved.

Pathologically, tuberous sclerosis is characterized by the presence of potato-like tumors, varying in size from 0.5 to 3.0 cm. in diameter. These tumors occur most frequently in the cerebral hemispheres. In the walls of the third and lateral ventricles, immediately beneath the ependyma, small irregular projections are found, arising usually from the thalamus. The microscopic alterations characteristic of the disease affect the pyramidal cells and the glia. Giant cells lie typically in the depth of the sclerotic nodules, *i.e.*, where the neuron and glial changes are most intense. A large cell of neuron type and a large cell with glial resemblance are distinguished.

Histopathologic studies of pulmonary and osseous manifestations of tuberous sclerosis have been scant. Berg and Zachrisson (*Acta radiol.* 22: 425, 1941) emphasized the irregular, honeycomb-like pattern in both lung fields, made up of scarcely visible to hazelnut-sized translucencies, separated by fine round striae. Skeletal involvement has been reported by various authors, whose observations are reviewed. A close study of the osseous changes reveals that they are not uniform. One finds bone sclerosis, periosteal thickening, bone rarefaction, and cyst formation. These changes may be an expression of physiopathological disturbance rather than of embryonal tissue dysplasia. The cases exhibiting skeletal changes showed the tubers to be located in the floors of the lateral ventricles and within the third ventricle. In other words, the lesions involved the thalamic and hypothalamic area of the brain. The significance of the hypothalamus in skeletal disorders has recently been emphasized by Lichtwitz (*Functional Pathology*, New York, Grune and Stratton, Inc., 1941). The polycystic lung disease is considered to be an expression of "embryoplasmaic dysplasia," a condition due to an anomaly of fetal differentiation.

A case is reported of a white male, aged 25 years, who complained of polyuria, nocturia, and pain in the chest, back, and both legs. Roentgen examination showed a honeycomb pattern of the lung fields with numerous multi-angular areas of increased translucency, separated by thickened fibrous strands. Skeletal changes consisted of erosion of the first lumbar segment with accompanying sclerosis. There were numerous cystic areas within the iliac, ischial, and pubic bones and in both femora. Blood calcium and phosphorus levels were normal. Blood chemistry did not support a

possible diagnosis of osteitis fibrosa cystica due to hyperparathyroidism. There was no demonstrable disturbance of the lipid metabolism. The patient was observed over a period of eight years.

CLARENCE E. WEAVER, M.D.

Gargoylism: Review of Literature with Report of Two Cases. Louis A. Lurie and Sol Levy. *Am. J. M. Sc.* 207: 184-195, February 1944.

The syndrome, variously called "gargoylism," dysostosis multiplex, Hurler's syndrome, and lipochondrodystrophy, is characterized by chondrodystrophic skeletal changes and deposition of a lipid-like substance in many of the body tissues.

Cases in two brothers, aged seven and six, are presented. The patients stood with all joints stiffly flexed. The head was retracted backwards and rested on the shoulders; it was larger than normal, with prominent bosses. The orbits were wide-set, the nose was saddle-shaped, and the lips were thick. A thoracolumbar kyphosis was present. Each patient had a barrel-shaped chest. Enlargement of the liver and spleen and umbilical herniae were present. Both patients showed hypertrichosis of the back and extremities. Corneal clouding, which is present in 75 per cent of the cases, was absent. There was laboratory evidence of definite liver damage.

The disease is congenital and familial in origin, affecting both sexes. Consanguinity plays no role; neither are the parents mentally defective. Usually, no abnormalities are present at birth, symptoms appearing between the first and second years, when a failure of normal development is observed. The condition is a lipid disturbance, since abnormal storage of lipid substances has been found, principally in the reticulo-endothelial cells, brain, cornea, pituitary, liver, spleen, and lymph nodes. These deposits appear as fine curved rod-like granules of as yet undetermined nature.

Roentgenographically, the skull is large and the sella is proportionately larger. The vertebral bodies may be poorly developed or even deformed. Bone ossification is retarded. The changes in the skull are probably not due to the lipid disturbance, but rather to a defect in the mesodermal anlage and faulty development of the sphenoid; the vertebral anomalies are probably attributable to faulty formation of the cartilage, while the retarded bone growth may be due to a pituitary factor. The restricted motion in the joints may be due to poor formation of the articular surfaces.

In Morquio's disease, from which gargoylism must be differentiated, there is no limitation of motion of the joints and the patients are not feeble-minded.

BENJAMIN COPELAND, M.D.

Hand-Schüller-Christian's Syndrome and "Eosinophilic or Solitary Granuloma of Bone." Oscar Versiani, José Maria Figueiró, and Moacyr A. Junqueira. *Am. J. M. Sc.* 207: 161-166, February 1944.

A woman aged 50, who also complained of polydipsia, suffered a pathological fracture within a year after a rarefied area was found in the middle of the left femoral shaft. All the other long bones were normal. A moderate anemia was present. The white cell count showed 6.5 per cent eosinophils.

A biopsy was performed, and a certain zone in the biopsy material showed an accumulation of eosinophils,

giving the picture of eosinophilic granuloma; another zone showed lipophages arranged like a lipogranuloma. Cellular hyperplasia and reticular thickening were apparent.

The authors believe that eosinophilic granuloma and Hand-Schüller-Christian's disease should be regarded as manifestations of the same process.

BENJAMIN COPLEMAN, M.D.

Eosinophilic Granuloma of Bone: A Condition Affecting One, Several or Many Bones, but Apparently Limited to the Skeleton, and Representing the Mildest Clinical Expression of the Peculiar Inflammatory Histiocytosis Also Underlying Letterer-Siwe Disease and Schüller-Christian Disease. Henry L. Jaffe and Louis Lichtenstein. Arch. Path. 37: 99-118, February 1944.

Eosinophilic granuloma of bone is seen mainly in children and adolescents, and sometimes also in young adults. One, several, or even many bones may be involved. With the possible exception of the hands and feet, almost any bone apparently may be the site of a lesion. In the cases in which more than a few bones are involved, those affected are likely to include one or more bones of the cranial vault, some of the ribs, one or more of the vertebrae and several of the long bones—especially the humerus and femur.

Clinical difficulties are usually limited to such local complaints as may arise from the skeletal lesions, systemic manifestations being entirely absent as a rule, even in the cases with multiple bone involvement. In these latter cases the clinical symptoms may be referable to a single lesion, all the others being silent at first or even consistently. Local tenderness and pain are the most common symptoms referable to an affected bone. In an occasional case, leukocytosis of moderate severity but not associated with any change in the differential count may be found. In some instances whether or not there is a leukocytosis, the differential count shows a slight increase of eosinophilic leukocytes.

There is nothing distinctive about the roentgenographic appearance of the individual lesion of eosinophilic granuloma. In cases involving a single bone the focus of destruction may, especially in light of the clinical picture as a whole, resemble a primary cancerous growth. In cases where several or many bones are involved, the roentgen appearance may suggest multiple myeloma, Ewing's tumor, skeletal metastases and, particularly in the presence of lesions in the skull, Schüller-Christian disease.

In general, the individual lesion presents itself roentgenographically as a small or large radiolucent zone. In the calvarium the lesions tend to appear more or less circular and rather sharply delimited, the zone of rarefaction even looking punched-out. Extensive resorption of the tables, particularly the outer table, will generally be found associated with swelling of the overlying soft parts. In a scapula or an innominate bone, too, the lesion tends to appear on the film as a rather circular, almost punched-out area of rarefaction. In a rib, the affected area, in addition to being rarefied, may be expanded and also fractured, and if fracture is present there may even be evidence of periosteal deposition of new bone and thickening of the overlying soft tissue. In the long bones, the lesion begins to evolve in the interior of the bone; as it enlarges, implicating the neighboring cortex, the

latter becomes eroded from the inside. The cortex may become expanded and even perforated, and where perforation has taken place, deposition of periosteal new bone may be observed.

On pathologic study a skeletal lesion in an early phase appears grossly as a more or less hemorrhagic and cystic area from which only a relatively small amount of granulation tissue can be curetted. This tissue, where it is not necrotic, is found to contain conspicuous numbers of histiocytes, including some revealing phagocytic activity, interspersed among which are more or less prominent accumulations of eosinophils, especially eosinophilic leukocytes.

Eosinophilic granuloma of bone, Letterer-Siwe disease, and Schüller-Christian disease may be considered as different clinico-anatomic expressions of the same basic disorder. This disorder apparently represents a peculiar inflammatory reaction to some as yet unknown agent of infection, and its individual lesions are characterized cytologically by the presence, at least at first, of large numbers of histiocytes. In eosinophilic granuloma of bone the lesions seem to develop only in the skeleton and often in a single bone, and are given a distinctive cytologic imprint by the abundance of eosinophils intermingled with the histiocytes. The lesions do not tend to become scarified, collagenized and lipidized, heal rapidly after simple curettage even without supplementary roentgen irradiation of the site, and may indeed heal by resolution without any therapeutic intervention whatever.

In Letterer-Siwe disease the histiocytic lesions are widely distributed through the soft tissues (especially the lymphoid tissues) and the skeleton, the marrow sometimes being extensively affected even when there are few actually destructive lesions in the bones. With Letterer-Siwe disease the bones of the skull, complete Christian triad—calvarial defects, diabetes insipidus, and exophthalmos. Though the lesions in the soft tissues in cases of Letterer-Siwe disease do not show infiltration by eosinophils, the destructive lesions of bones do show it, especially early in their evolution. Indeed, the granulation tissue in such destructive lesions of Letterer-Siwe disease is indistinguishable microscopically from such tissue in corresponding lesions of eosinophilic granuloma of bone. In a case of Letterer-Siwe disease running a relatively protracted course of a year or more one is likely to find that some of the lesions (especially those in the skeleton and those in the thymus and lungs) are becoming scarified, collagenized and lipidized, the case thus passing over into the domain of Schüller-Christian disease.

Schüller-Christian disease represents the basic disorder in its most chronic and on the whole most miscellaneous form, the presence or the absence of the Christian triad depending merely on whether or not the skull has been heavily involved. However, any case which is placed in this category should be expected to show, as the anatomic prerequisite, at least some lesions which have already become scarified, collagenized, and lipidized and are hence classifiable as lipogranuloma.

Renal Rickets Syndrome. W. G. Hayward. J. Urol. 51: 278-286, March 1944.

The author presents two cases: one of dwarfism, bilateral hydronephrosis, moderate disturbance of calcium-phosphorus ratio, and no bone changes, with

improvement following operative correction of renal and ureteral anomalies; the second, of dwarfism, hydro-ureter, osteoporosis and epiphyseal changes, and high serum phosphorus, terminating fatally.

Renal rickets is a disease of youth, the average age of onset being twelve or fourteen years; it occurs equally in boys and girls. Typically it is characterized by dwarfism; usually bright mentality; bony changes, chiefly genu valgum, which is present in about half the cases; roentgen findings suggestive of ordinary rickets; thirst, polyuria, dry skin, anorexia, headache, delayed sexual development, and in various degrees poor renal function, azotemia, a low serum calcium and high serum phosphorus. The three outstanding features are the dwarfism, rachitic changes, and the calcium-phosphorus reversal.

Any renal disease which causes retention of phosphorus may lead to renal rickets. Under these conditions phosphorus is eliminated into the bowel, where it combines with calcium to form insoluble calcium phosphate. This the bowel cannot absorb, and reduction in serum calcium results. The excessive phosphorus causes hyperplasia of the parathyroids, which in turn creates decreased density of bones with fibrosis and cystic changes. Large parathyroids have been found at autopsy. Some writers feel that imbalance of the calcium-phosphorus ratio is more important than the total amounts of the elements. Tetany is very rare, apparently because the serum calcium never falls low enough.

Prognosis is almost 100 per cent unfavorable. Only two years of life are to be expected after bone changes occur.
EDWIN L. LAME, M.D.

Osteomyelitis of the Odontoid Process of the Axis (Dens of the Epistropheus). T. J. F. Frank. M. J. Australia 1: 198-202, March 4, 1944.

Acute osteomyelitis of the vertebrae is a rare disease. The site of the infection in the vertebral body, laminae, and processes is usually more important than the part of the spinal column affected. If the focus is localized in the anterior part of the body or on the periphery of the vertebra or lamina, the infection is more apt to follow the fascial planes and spinal muscles with the production of better opportunities for eventual drainage of an abscess. Lesions of the spinous and transverse processes may finally result in superficial abscesses, which can be easily drained. If the disease affects the posterior part of the vertebral body or the inferior surface of the lamina, meningitis or meningomyelitis may arise through direct spread of the infection or from rupture of the pus into the spinal canal.

Osteomyelitis of the spine is usually the result of a blood-borne infection from a primary focus elsewhere. The organisms most commonly found are *Staphylococcus aureus* and *albus*, the pneumococcus, the streptococcus, and *Bacillus typhosus*.

Acute osteomyelitis of the vertebrae may occur at any age before their ossification is complete and sometimes later. Twelve to fifteen years has been given as the age of election. The mortality is high, averaging about 45 per cent.

Involvement of the cervical vertebrae is especially rare. It may be mistaken for spontaneous hyperemic dislocation of the atlas, which is also unusual.

A case is reported in a man 43 years of age. The right index finger became swollen and this was fol-

lowed by cellulitis of the hand and forearm, which responded to multiple incisions and sulfapyridine. Two weeks later the left ankle became painful and swollen. Later there was transient pain in the groin, and two weeks afterward the neck became stiff and painful. A few enlarged cervical nodes were present. The blood count showed evidence of infection. X-ray examination of the neck was negative at this time. Two weeks later, however, some osteoporosis of the odontoid was demonstrable and a diagnosis of osteomyelitis was made. Examination by x-ray nine days later did not show any additional bony changes, but in another twelve days roentgenograms revealed a pathological fracture of the base of the odontoid process, which was displaced a quarter of an inch to the right. Lumbar puncture yielded clear spinal fluid, containing a few white cells but no increase in globulin.

The patient died seven weeks after entering the hospital. Postmortem examination showed a thick-walled abscess in the left upper lobe of the lung. The peritoneal sac contained several pints of clear yellow fluid. Large perinephric collections of green-yellow pus were found, and there were several abscesses in each kidney. The cultured organism was *Staphylococcus aureus*. The odontoid process of the axis was congested, rarefied, and eroded, and a complete fracture was present just below the level of the articular surface. Microscopic examination of the odontoid process revealed an acute osteomyelitis.

DONALD R. LAING, M.D.

Role of Aseptic Bone Necrosis in Hip Lesions. Ernst Bergmann. Am. J. Surg. 63: 218-235, February 1944.

Because of the arrangement of vessels supplying the head of the femur, impairment of the blood supply with consequent aseptic necrosis is of particularly frequent occurrence at this site.

In fractures of the femoral neck the blood supply to the head is either greatly impaired or altogether cut off and aseptic necrosis ensues. Too much significance need not be attached to this, however, so far as immediate healing is concerned, for with proper reduction the chances for bony union are still good, since the adjacent living bone of the distal fragment can unite with the head before this has gone through all the stages of reorganization. The true significance of aseptic necrosis in fractures lies rather in the possibility of late damage—the collapse of an area of residual necrosis one or two years after bony union is complete. This may occur after any of the approved methods of treatment, and no means of predicting or preventing it are known.

Epiphyseal separation may or may not be accompanied by ischemic necrosis. On the whole, its role is a minor one. The author cites one case in which, six months after apparent healing, the entire epiphysis collapsed. In another case, three years after reduction, evidence of residual necrosis was observed roentgenologically, though due to its position in a sector not subject to full weight-bearing pathological fracture did not occur. Forceful manipulation of slipped epiphyses should be avoided, as this may jeopardize what remains in the way of blood supply or has been re-established through adaptation.

In *traumatic dislocation* of the hip, as in fractures, wedge-shaped areas of necrosis may persist and collapse after a considerable interval, under the strain of weight-bearing. In *congenital hip dislocations* the capsule is intact and the capsular vessels have time for

the necessary adjustment, but even so an occasional case shows a necrotic area after the patient has reached adult life.

Perthes' disease differs from the conditions previously described in the absence of any frank traumatic factor; yet autopsy and surgical specimens reveal the characteristics of aseptic bone necrosis. The explanation of these changes is not clear. Minor repeated or permanent mechanical effects, such as are associated with almost normal activities—so-called "microtraumata"—have been suggested as a causative factor.

The loose bodies or joint mice characteristic of *osteocondritis dissecans* show under the cover of living articular cartilage a necrotic bony core. Here, too, a satisfactory explanation is wanting, but mechanical effects seem to play a role.

Only in *caisson disease* is embolic interruption of the circulation unquestionably accepted as the cause of the subsequent aseptic necrosis.

Osteoarthritis may be accompanied by collapse and demarcation of areas of necrotic bone in the weight-bearing sector but, as in *osteocondritis dissecans*, the explanation is a matter of conjecture.

Finally, the author mentions tuberculosis of the femoral head. "Certain forms of epiphyseal tuberculosis," he says, "due to vascular occlusion through embolism by tuberculous material may be accompanied by anemic infarcts of truly aseptic type."

Roentgenographic Diagnosis of Torsional Deformities in Tubular Bones. Henry Milch. *Surgery* 15: 440-450, March 1944.

Commonly, the determination of rotational displacement of the long bones depends upon exposure of the entire bone to roentgen beams which diverge from each other by known angular amounts. While this method affords an excellent opportunity for the scientific measurement of the degree of rotation of a known anatomic prominence, such as the femoral neck, it is not always conveniently applicable, particularly when there has been a loss of continuity in the shaft of the bone. From a practical point of view, it is seldom, if ever, necessary to determine the degree of such rotations with mathematical precision, provided the direction can be accurately demonstrated. The author presents "a few simple observations" which have been found helpful.

In recent fractures the presence of rotation of one fragment upon the other around a longitudinal axis must be envisaged when a disproportion persists between the fracture ends. In the absence of any marked telescoping of the bone ends, this appearance can arise only from a rotational displacement, since long bones are, in general, irregularly polygonal or elliptical, but almost never truly circular in outline.

Failure to recognize the presence of rotation may account in no small measure for the difficulty experienced in the treatment of spiral or malleolar fractures of the tibia, fractures of the femoral neck, and especially supracondylar fractures of the humerus. In the latter case, the thinness of the bone in the supracondylar region makes the retention of end-to-end reduction most precarious and it is probably because of the persistence of some rotation that more marked displacement can be avoided.

Rotation of the fragments of a supracondylar fracture is betrayed by cross-sectional disproportion. The direction of rotation, however, requires other observa-

tions. These are based upon the principle of determining the projection relationship between two transverse axes which normally converge at known angles. In the case of the femur these are the bicondylar axis and the axis of the femoral neck.

Using the direction of any normal bony projection as an axis of reference, the same method for the determination of torsion can be applied to all the long bones. Once the normal angular relationship of the prominence to any other transverse axis is known, torsion existing between the two axes can be roentgenographically established and, if necessary, measured. However, it is essential that the whole bone be radiographed on a single plate, since both axes of reference must be projected on the same film.

In the humerus, the lower or bicondylar axis is preferable to the upper axis because of the shortness of the humeral neck. The axis of the head and neck is retroverted and makes a backward and inward angle of about 20 degrees. Hence, the neck should always be foreshortened in relation to the bicondylar axis when the fragments are in normal alignment.

Examination of the ulna discloses that in its anatomic position the coronoid process points almost directly forward, while the styloid process, at its distal end, points almost directly backward. It follows, therefore, that the clear outline of the styloid process on a routine anteroposterior view and its absence on a routine lateral view are pathognomonic of torsion in the ulna.

In the radius, the situation is exactly opposite. The absence of the radial styloid process in a routine anteroposterior view and its presence on a routine lateral view are pathognomonic of torsion.

In the leg, because of the absence of prominent lateral projections, the roentgenographic recognition of torsion is somewhat more difficult. The medial projection of the internal malleolus is so slight as to make it practically valueless for establishing an axis of comparison with the bicondylar axis of the tibia. However, the method here described can be employed with slight modification. On a true lateral view, with the axis of the knee joint perpendicular to the roentgen film, the long axis of the fibula normally lies posterior to the longitudinal axis of the tibia. This is, of course, due to the fact that the bimalleolar axis of the ankle joint is normally externally rotated 20 to 25 degrees from the bicondylar axis of the tibia. Using this relationship as a norm, it will be seen that external rotation of the tibia serves to increase the apparent displacement of the fibula on the lateral roentgenogram of the tibia. Internal torsion, on the other hand, results in a relative forward displacement of the malleolar head in the lateral view. The demonstration of this phenomenon, however, depends upon securing an absolutely true lateral view of the upper end of the tibia, as a norm, against which comparison may be made.

J. E. WHITELEATHER, M.D.

Fractures of the Tibial Condyles. Wm. L. Weber. *California & West. Med.* 60: 96-98, March 1944.

Fractures of the tibial condyle may be the result of indirect or direct violence. The indirect type of fracture is the result of falling upon the feet with the leg in extension, or of forcible abduction or adduction at the knee with the leg fixed. Direct violence includes severe blows and crushing injuries just below the knee joint. The so-called "bumper" fracture is an example.

The joint surfaces are involved in nearly all tuberosity fractures and the horizontal plane of the tibial condyle is in malalignment. The head of the fibula may be fractured, too.

Roentgenograms are essential in determining the extent of the fractures and the type of treatment. Therapy is conservative. The author uses a modified Forrester technic. Early motion is advocated, but weight-bearing is never begun before six to eight weeks have elapsed, and then only with the protection of a long caliper brace. The author does not advise immediate open reduction.

MAURICE D. SACHS, M.D.

Combination of Nail and Screw for the Fixation of Fractures of the Neck of the Femur. Herbert A. Johnston. *Am. J. Surg.* 63: 329-336, March 1944.

The author describes his method for the fixation of hip fractures, using a combination nail and screw. This screw has a channel from end to end so that it readily follows a guidewire. It also has a slot from end to end for the reception of a key, which is the same length as the screw and is easily inserted. The key is thicker on the inner border and is made to fit the guide-wire channel. It is flat and when inserted projects through the slot from end to end of the screw. It is driven in after the screw is inserted. The screw provides compression of the fragments and the key becomes a flange which prevents its change of position and also prevents rotation of the head.

This device may be inserted by any method of choice—large incision or small puncture. The author uses a puncture operation, inserting the screw under fluoroscopic guidance. With the technic which he describes, the periods of exposure to x-rays are brief and the operator's hands are well out of the field of danger, so that he runs no serious risk.

Pneumoroentgenography of the Knee Joint. P. P. Hauch. *Brit. J. Radiol.* 17: 70-74, March 1944.

The technic employed by the author for pneumoroentgenography of the knee joint is as follows. Under aseptic precautions 100 to 140 c.c. of oxygen are injected into the knee joint and a snug elastic bandage is applied. Radiographs are made in the posterior-anterior projection of each half of the joint in forced abduction and adduction. Oblique, lateral and antero-posterior views are also taken if indicated. Better results are obtained if the films are slightly overexposed and under-developed. Oxygen is used in preference to air, as it is more quickly absorbed. There is no undue pain or discomfort during or after the procedure.

It is possible to identify tears and hypermobility of the menisci, loose bodies, injuries to the cruciate ligaments, injuries to the cartilages of the femur and tibia, hypertrophy of the fat pads, calcification of the menisci, cysts, and minute fractures. In a series of 21 cases the procedure described was found to be highly accurate.

SYDNEY J. HAWLEY, M.D.

Soft Tissue Complications of Fractures of the Leg. A. B. Sirbu, M. J. Murphy, and A. S. White. *California & West. Med.* 60: 53-56, February 1944.

Valuable time is lost in the treatment of fractures by paying too much attention to bone fragments and giving inadequate consideration to the extent of injury to

adjacent soft tissues and the sympathetic nervous system. During the past two years the authors have been collecting a series of cases involving trauma of the extremities with vascular complications. These include (1) generalized arterial occlusion of the leg due to vasospasm; (2) Volkmann's ischemic paralysis of the leg with gangrene of the anterior crural muscles; (3) localized gangrene of the anterior tibial muscle.

Eight illustrative cases are presented. The role that the sympathetic nervous system plays in the production of arterial spasm and the relationship of the latter to ischemia and even gangrene of an extremity are discussed.

The authors state that in all traumatic injuries of the extremities a careful search should be made for evidence of vascular and nerve involvement; that evidence of arterial spasm, either as an early or delayed complication, should be sought; that a lumbar sympathetic or stellate ganglion block should be done in all cases of circulatory impairment and, if that is not satisfactory, a periarterial sympathectomy or arteriectomy should be performed.

MAURICE D. SACHS, M.D.

Subastragaloid Dislocation. Report of an Unusual Ski Injury. Merle J. Brown and Walter E. Brown, Jr. *Am. J. Surg.* 63: 276-277, February 1944.

A case of subastragaloid dislocation of the left ankle occurring during military skiing is reported. While coming down a hill at a moderate speed, the patient lost control and began to fall. The front end of the ski caught in a tree. As the forward momental force carried the weight of the body past the tree, a torsion external rotating force was produced on the left ankle. Examination immediately following the accident showed a deformity of the left ankle with the foot projecting at a 90° angle lateralward in relation to the leg, with general diffuse swelling. Roentgenograms showed a complete dislocation of the os calcis on the talus, with 90° lateral rotation of the foot, the scaphoid bone being separated anteriorly from the talus. Successful reduction was finally accomplished, as shown by x-ray examinations, and a cast was applied. An x-ray check-up two weeks following the accident showed a normal left ankle joint. The patient was discharged to full duty approximately four weeks after the injury. Roentgenograms are reproduced.

Vertebral Fractures in Metrazol Therapy With and Without the Use of Curare as a Supplement. N. L. Easton and Joseph Sommers. *J. Nerv. & Ment. Dis.* 99: 256-263, March 1944.

In a series of 800 metrazol-treated cases, a fracture incidence of 26.1 per cent was found. All of the fractures occurred in the bodies of the dorsal spine, the fourth, fifth, and sixth vertebrae being the most frequently injured. The incidence was 37.2 per cent in males compared with 16.8 per cent in females. There was also an average of 2.8 bodies involved in the male compared with an average of 2.1 bodies per female. The authors believe that the greater muscular development in the male accounts for the higher incidence of fracture and greater number of bodies affected.

In 275 patients treated with curare and metrazol, the fracture incidence was 5.8 per cent: 7.3 per cent in males and 4.6 per cent in females. The degree of compression of the bodies and number of vertebrae involved were also less than with metrazol alone.

Kyphosis, scoliosis, arthritis, nuclear change, and old fractures are no contraindication to metrazol therapy. Osteoporosis, however, is a definite contraindication to the use of metrazol alone.

The authors conclude that curare should be used as a supplement whenever metrazol "shock" therapy is employed.

E. W. GODFREY, M.D.

Acute Calcified Subacromial or Subdeltoid Bursitis. Frank R. Guido. *California & West. Med.* 60: 69-72, February 1944.

Calcified subacromial or subdeltoid bursitis is not rare. In a series of over 6,000 unselected apparently healthy persons, Bosworth (*J. A. M. A.* 116: 2477, May 31, 1941) found calcium deposits in one or both subacromial bursae in 2.7 per cent. The seat of the disease has been shown to be in the floor of the bursa, which is closely aligned with the tendons of the short rotators of the humerus, especially that of the supraspinatus muscle, and it is the tendon of this latter muscle that is most commonly involved.

The etiology of subacromial or subdeltoid bursitis is not known. The present consensus is that it is a gradual degenerative process, with multiple trivial traumata playing some part.

Symptoms include agonizing pain in the shoulder joint, tenderness over the greater tuberosity, pain on rotation, and inability to abduct the involved extremity, which is held rigidly at the side. Roentgenograms reveal a calcareous deposit (occasionally multiple deposits) over the greater tuberosity. This varies in density and thickness. Sometimes fluoroscopy is useful in its localization. Acute symptoms usually persist for about two weeks.

Although some patients experience spontaneous relief, the author is of the opinion that immediate incision of the involved bursa and curettage are the best form of therapy. For patients who refuse surgery, the injection of procaine hydrochloride into the bursa has received favorable mention in the literature. High-voltage roentgen therapy has also been employed, but the results have not been striking. Chapman (*California & West. Med.* 56: 248, 1942; *Abst. in Radiology* 39: 511, 1942), using this form of treatment in 54 cases, obtained no relief in 22 per cent, slight relief in 10 per cent, marked but incomplete relief in 46 per cent, and complete relief in 22 per cent. Other measures which have been tried with more or less effectiveness are physiotherapy, needling of the bursa, bursal irrigations, and ammonium chloride orally with rest of the involved arm and other supplementary measures.

The author reports a series of 11 cases. Surgical incision was done in 7, with prompt relief. In 3 cases immobilization and analgesics brought about relief in two or three weeks. One patient refused treatment.

MAURICE D. SACHS, M.D.

GYNECOLOGY AND OBSTETRICS

Venous Intravasation During Utero-Salpingography. E. Rohan Williams. *Brit. J. Radiol.* 17: 13-17, January 1944.

Venous intravasation may occur during utero-salpingography as a result of direct trauma to the uterine mucosa by the cannula, the use of excessively high pressure, the performance of the test when the endometrium is physiologically deficient, *i.e.*, too near

menstruation or too soon after curettage or dilatation of the cervix.

Fluoroscopically this complication is first seen as an ill-defined opacity near the uterine cavity, followed by the appearance of streak-like shadows radiating laterally. On films an interlacing network may be seen adjacent to the uterine cavity. As the intravasation increases, the oil is seen as coarse linear opacities in the uterine veins. It usually breaks up into globules as the injection proceeds.

In 6 cases reported by the author, no untoward symptoms occurred, but instances of chest pain and cough, probably the result of oil embolism, have been reported and two deaths from oil embolism have been recorded.

SYDNEY J. HAWLEY, M.D.

Anencephaly with Antenatal Roentgen Diagnosis in Three Cases. W. C. Winn, H. H. Ware, Jr., and F. B. Mandeville. *Virginia M. Monthly* 71: 145-148, March 1944.

Throughout the literature there seems to be general agreement that, whenever hydramnios is suspected clinically, a fetal monstrosity should be considered. Anencephaly is considered a monstrosity which can be diagnosed by adequate anteroposterior and lateral roentgenograms during the latter half of pregnancy.

A review of the obstetrical records at the Medical College of Virginia Hospitals for a period of ten years, 1933 to 1942, inclusive, revealed 71 cases with polyhydramnios. In 7 of these, gross deformity of the fetus was noted. There were 3 fetal monstrosities, 3 cases of erythroblastosis of the hydrops variety, and 1 infant had clubbed feet. One anencephalic monster was diagnosed roentgenographically before delivery.

Three case reports with roentgenograms are included in the paper. The authors conclude that roentgen examination of the abdomen in all cases of polyhydramnios is advisable. If a monstrosity is found, it is best to keep the mother in ignorance of the fact and interrupt the pregnancy.

The small quantity of roentgen radiation necessary for the examination, less than 1/50 of an erythema dose, is not considered dangerous for mother or fetus.

J. E. WHITELEATHER, M.D.

Fallacies in Soft Tissue Placentography. Chasear Moir, with a Comment by A. Louis Dippel. *Am. J. Obst. & Gynec.* 47: 198-212, February 1944.

This paper is a criticism of the method of soft-tissue placentography described by Snow and his associates and by Dippel and Brown (see *Absts. in Radiology* 36: 130, 756, 1941).

A representative series of roentgenograms was obtained from normal patients in the last eight weeks of pregnancy. In almost every instance a localized thickening of the uterine wall could be clearly seen. The corresponding thickening in their films was interpreted by Snow and Dippel and their co-workers as representing the placenta. The author, however, believes it to represent not only the placenta but also a localized excess of amniotic fluid, due to the uneven position of the fetus in utero. He objects also to the assumption that the placenta and liquor amnii cast shadows of different density, believing it much more likely that these shadows are indistinguishable.

To substantiate his views, Moir presents a series of experiments. In the first, roentgenograms were made of a normal fresh placenta suspended, fetal surface up-

ward, from a wire loop. The inner surface of the placenta was clearly outlined. A quantity of normal liquor amnii was then poured into the saucer-shaped placenta and a second exposure was made. The placental surface disappeared, indicating that the radiopacity of tissue and fluid were too nearly alike to show any differentiation even under these ideal conditions.

The second experiment was a repetition of one made by Weintraub and Snow, in which a roentgenogram was made of a stillborn fetus immersed in amniotic fluid, and confirmed in the main their conclusion that the dark band seen normally surrounding the fetus in utero is of fetal origin, the result of the relative transparency of the subcutaneous tissues of the fetus. It does not represent a layer of amniotic fluid.

Measurements were then made of 25 unselected placentas; the fact that these were notably less than the shadows usually interpreted as placentas is regarded as strong presumptive evidence that the latter were produced, at least in part, by amniotic fluid. This would explain the indentations or "digitations" on the "placental" surfaces mentioned by Snow.

To confirm his theory further, the author applied pressure by means of a sheet of firm cardboard over the abdominal wall where the uterine shadow was broadest. The resulting change in the roentgenographic appearance was considered to be consistent with a local excess of amniotic fluid. The fluid was also displaced by introduction of a small quantity of air per catheter, and roentgenograms were obtained with the patient in various positions to show the air-bubble. After air-injection, the localized thickening disappeared and the uterine wall was revealed in its true thickness, with no evidence of placenta.

In view of these experiments, the conclusion is reached that positive findings by soft-tissue placentography should be accepted with reserve, though negative findings may have a limited field of usefulness. The illustrations and diagrams are of high quality and merit study.

Dippel defends his position in an appended Comment. He questions the validity of roentgenograms of the delivered placenta as proof of Moir's contentions, since it cannot be considered roentgenographically identical with the undelivered and functioning placenta, which contains more blood. STEPHEN N. TAGER, M.D.

THE GENITO-URINARY TRACT

Pelvic Single Kidney: Report of Case. Oswald S. Lowsley and Joseph H. Menning. *J. Urol.* 51: 117-127, February 1944.

A 36th case of pelvic single kidney is added to the 35 previously recorded in the literature. Among these cases, the mortality has been high, at least 9 patients having died as a result of their renal anomalies. Eighteen of the 36 patients have had anomalies, also, of the genital structures. For this reason these authors make the point that every case of genital abnormality should be investigated from the point of view of renal structure, and if anomalies are found these should be corrected.

The case report is of a boy of seven and a half years who had had repeated urinary tract infections. A pelvic single kidney was present, demonstrable by pyelogram and intravenous urogram. The function of this kidney was good. Several days after admission the kidney was elevated as high as possible in the abdomen

and the ureter was reimplanted in the bladder. The technic of the operation is discussed and excellent drawings are included. The boy had been followed fifteen months and was still well.

The roentgenograms which are reproduced do not show the condition very clearly.

JOHN O. LAFFERTY, M.D.

Tuberculoma of the Kidney. Report of a Case. Stanley L. Wang and Albert V. Flaque. *J. Urol.* 51: 275-277, March 1944.

Tuberculoma is a vague term which the authors believe represents an unusual type of tuberculosis in which the lesion has the appearance of a tumor. The condition is rare, only two cases involving the kidney having been previously reported in the literature.

A 17-year-old white male was admitted with a complaint of "hematuria" of one week's duration. Two members of his family had died of tuberculosis. On cystoscopy the bladder showed spots of ecchymosis and an ulcerated sloughing area in the region of the left ureteral orifice. No pyelogram could be made of the left kidney, since a catheter would not pass up the ureter. Films of the abdomen showed a large renal shadow and an area of increased density in the lower pole. Intravenous urography showed delayed excretion on the left side; also, dilatation with apparent excavation at the upper pole. At operation the kidney appeared to be the seat of a tumor and nephrectomy was done. Two-thirds of the kidney was converted into a yellow-gray granular mass which was rubbery in consistency and produced a stenosis where the calices met the pelvis. Sections revealed tuberculous granulation tissue in the form of miliary and conglomerate tubercles. Tubercles were found in the ureter.

The postoperative course was uneventful. The patient received routine follow-up treatment for postoperative urological tuberculosis, consisting of graduated rest, fresh air, special diet, tuberculin, and quartz lamp irradiations. DAVID KIRSH, M.D.

THE VASCULAR SYSTEM

Use of Phlebography and Lumbar Sympathetic Block in the Diagnosis of Venospasm of the Lower Extremities: Preliminary Report. E. M. Papper and Allison E. Imler. *Surgery* 15: 402-412, March 1944.

In recent years, investigators have made increasing use of phlebography in the diagnosis and treatment of thrombophlebitis and pulmonary embolism resulting therefrom. There are still many controversial problems, however, connected with its use. One of these is the correct interpretation of filling defects in veins. Conceivably, these abnormalities may be due to partial or complete occlusion of the veins by thrombi, venous spasm, or both. The differentiation of these conditions is of practical and theoretical importance, as it is agreed by most writers that ligation is indicated in the presence of suppuration of the veins and phlebotrombosis.

This report presents an effective and simple technic whereby venous spasm may be differentiated from thrombosis with the aid of lumbar sympathetic block. The demonstration by phlebography of a uniform symmetrical narrowing of a vein with adequate concentration of contrast material is suggestive of venospasm. This diagnosis is confirmed if, following lumbar sympathetic block, the deformity disappears.

The authors describe the technic of phlebography and lumbar sympathetic block as performed for this purpose. If the first phlebographic study shows abnormalities, it is repeated to rule out technical errors such as inadequate concentration of media, and serial films of the involved area are made.

Three cases are reported, with illustrative roentgenograms. The first case showed a constriction of the popliteal vein which disappeared one hour after sympathetic block. In the second case, phlebography revealed normal deep circulation bilaterally except for a moderate symmetrical constriction of the left external iliac vein. After sympathetic block there was a definite increase in the width of the external iliac vein and relief persisted for eighteen hours. The third case exhibited thrombophlebitis of the right great saphenous vein, which had developed following an injury; ligation of this vein had been performed at another hospital five months after the onset. Phlebography revealed thrombosis of the deep femoral system with obstruction of the superficial femoral veins and thrombosis of the profunda femoris vein, with partial recanalization. These defects were again demonstrated by phlebography five weeks later, together with a uniform constriction of the distal end of the popliteal

vein and the proximal portion of the anterior and posterior tibial veins which was not present previously. After lumbar sympathetic block, there was some widening of the constricted veins, although a defect in filling of the posterior tibial vein persisted. This case illustrates the coexistence of thrombosis and superimposed venospasm.

Commenting upon their observations, the authors state that the procedure described demonstrates, first, that there is an entity of venospasm; second, that thrombophlebitis may set up a reflex venal spasm about the diseased area. They suggest that the deep veins of the lower extremities are innervated by the lumbar sympathetic outflow and that it is possible, as demonstrated in their cases, for excessive tone of this outflow to produce spasm of the deep veins. Denervation by lumbar sympathetic block effectively removes the excess venous tone and allows the veins to dilate.

More experience must be acquired as to the correct time interval for phlebography after nerve block, and until more information can be obtained, it seems advisable to obtain serial roentgenograms.

J. E. WHITELEATHER, M.D.

RADIOTHERAPY

NEOPLASMS

Malignant Tumours of the Upper Jaw (The Skinner Lecture). B. W. Windeyer. *Brit. J. Radiol.* Part I. 16: 362-366, December 1943. Part II. 17: 18-24, January 1944.

In this discussion of tumors of the upper jaw, the author considers tumors of the maxillary sinus, ethmoidal tumors, and tumors involving the alveolar process; 141 cases of carcinoma and 12 of sarcoma are the basis of his study. Fifty-one patients were males and 72 females. These tumors occur rarely before the age of thirty-five, being most common between sixty and seventy. There is no correlation with chronic sinus disease.

Classification of tumors of the upper jaw is not altogether satisfactory. The antral tumors, however, may be divided into those arising in the region of the alveolar sulcus and those of the antro-ethmoidal angle. The spread may be through the mesial wall into the nose, into the ethmoid sinuses, through the orbital plate, or laterally into the cheek.

Histologic confirmation was obtained in 127 of the author's series—115 carcinomas and all the sarcomas. Re-examination of 75 specimens for the purposes of this report showed 22 keratinizing squamous-cell carcinomas, 23 squamous-cell carcinomas with little keratinization, 18 transitional-cell carcinomas, 9 undifferentiated spheroidal carcinomas, and 3 adenocarcinomas.

Metastases were found both in the regional lymph nodes and at distant locations. In 45 cases large nodes were present on admission, some of them, however, probably due to secondary infection. Generalized metastases were present in 14 cases.

Radiography is useful in confirming the clinical diagnosis and in determining the extent of the growth. It is not of value in detecting early recurrence. Biopsy is useful both for diagnosis and prognosis.

Treatment must be adjusted to the conditions and consists of surgery, implantation of radium, and external irradiation. Numerous methods were employed in the series recorded here. Since 1936 the general practice has been to give external irradiation either with roentgen rays or the teleradium unit, followed by surgery after the radiation reaction has subsided. Subsequent steps depend upon the condition found at operation. If there is residual tumor tissue, radium is applied. The plan of irradiation for a typical case is given in detail. Unless cervical lymph node metastases are present, the authors do not treat the neck. In 3 of their series a block dissection was done and in others x-ray or radium irradiation. Complications of treatment include bone necrosis, bronchopneumonia, and meningitis. Destruction of the eye, requiring subsequent removal, occurred in 10 cases.

Of 153 cases, 23 were considered too advanced for treatment. Of 69 patients treated between 1925 and 1935, 13 (18.8 per cent) were symptom-free at the end of five years. Of 30 treated in 1936-1939 (with the present technic), 11 (36.6 per cent) were free of symptoms at the end of three years. Only 1 of 9 patients with sarcoma treated prior to 1937 was symptom-free for five years.

SYDNEY J. HAWLEY, M.D.

Carcinoma of the Nasopharynx. Charles M. Thompson and Elmer L. Grimes. *Am. J. M. Sc.* 207: 342-348, March 1944.

Carcinoma of the nasopharynx comprises about 2 per cent of any large series of cancer cases and affects a group with a mean age of forty-five years. The incidence of cervical node metastasis upon hospital admission ranges in various reported series from 27.5 to 77 per cent. About 30 per cent of the patients mention nasal obstruction, discharge, or epistaxis as the first symptom. About 30 per cent have paralysis of one or more cranial nerves, the most frequently in-

volved being the fifth, sixth, and ninth, with the production of facial pain, diplopia, or dysphagia. These findings, and headache, are due to extension of the tumor into the skull. Since most of the tumors arise in or near the fossa of Rosenmüller, unilateral deafness, tinnitus and stuffiness in an ear are encountered. The average duration of symptoms before diagnosis is about fifteen months. Much time is usually lost on unwarranted operations such as tonsillectomies and mastoidectomies.

The term "lymphoepithelioma," which is applied to this neoplasm, arises from the fact that the site of origin is one in which lymphoid tissue abounds, and that the tumor is an anaplastic carcinoma with many lymphocytes mixed in coincidentally. The authors classify their 17 proved cases into three groups, the last with three subtypes, on the basis of the microscopic appearance. Group I lesions tend to metastasize widely to lungs and liver, while Group III lesions show a striking tendency to metastasize to the cervical nodes and extend directly to the middle cranial fossa.

Irradiation is the only accepted form of treatment. Profoundly ill patients are dramatically relieved temporarily by irradiation. Several patients were rendered free of the primary and cervical node lesions for weeks or months. Recurrences or metastases other than to the nodes proved radioresistant. The low percentage of cures is ascribed to late clinical recognition.

BENJAMIN COLEMAN, M.D.

Diagnosis, Classification and Treatment of Tumours of the Salivary Glands. A Symposium. Reginald T. Payne, Margaret C. Tod, and M. Lederman. *Brit. J. Radiol.* 17:3-12, January 1944.

R. T. Payne: Tumors of the salivary glands constitute 1 to 2 per cent of all tumors. Pathologists still dispute their origin and classification. Among the congenital tumors which have been reported are hemangioma, lymphangioma, cysts, mixed tumors, and carcinoma (a single case). Lipomas are the only benign connective-tissue tumors of importance. Branchial cysts may involve the parotid region and other tumors may undergo cystic change. Pure adenoma and adenolymphoma are rare. Mixed tumors constitute the largest and most important group. These are commonest in the parotid. They may undergo malignant change. They recur frequently after removal, but seldom metastasize. Sarcoma is rare.

The treatment of salivary gland tumors is predominantly surgical. Each case must be individualized. Irradiation rarely reduces the size of these tumors, though it may toughen the capsule and make surgical removal easier. The operative complications are facial palsy, salivary fistula, and the auriculo-temporal syndrome. Because of the varied character of the tumors, it is difficult to make an accurate prognosis. Recurrence occurs in from 20 to 45 per cent of cases. The longer the follow-up the greater the number of recurrences found.

M. C. Tod: This part of the discussion is concerned solely with treatment and deals chiefly with parotid gland tumors, though mixed tumors in other sites are briefly considered. A group of 52 patients with mixed tumors of the parotid gland treated by surgery followed by radium implantation showed 98 per cent five-year cures. In 48 there was no recurrence, and in 3 recurrences were successfully treated. The dose employed was 6,000 to 6,500 r in seven or eight days.

Eleven cases of mixed tumor were treated by surgery and roentgen irradiation, but this procedure has been used for two years only, so that late results are not available. Only one of this group had required re-treatment for recurrence.

Radiation alone was used chiefly in old patients with large tumors. The group is too small for the results to be significant. In some cases the tumors disappeared entirely, but not sufficient time has elapsed to evaluate recurrence.

Malignant tumors received the same types of treatment as the mixed tumors. Of 10 patients treated with surgery and implantation 3 were well at the end of three years. Of 7 treated by surgery and x-ray 2 were well at the end of three years. Of 7 treated by x-ray alone 2 were well at the end of two years. The inclusion in this group of lymphosarcoma, which is genuinely radiosensitive, accounts for some of the favorable results.

Surgical removal followed within a month by a single course of irradiation to tolerance seems to be the best method of treatment for mixed tumors. When surgical removal is impossible or contraindicated, irradiation to the highest possible dose is indicated.

M. Lederman: The following simple classification of salivary gland tumors is recommended as of practical value to the radiotherapist:

Epithelial tumors

Benign

Mixed tumor type

Non-mixed tumor type

Adenoma

Adenolymphoma

Basalioma

Malignant

Mixed tumor type

Non-mixed tumor type

Adenocarcinoma

Malignant adenolymphoma

Basal-cell carcinoma

Squamous-cell carcinoma

Connective-tissue tumors

Benign

Fibroma

Lipoma

Angioma

Lymphoid tissue

Malignant

Fibrosarcoma

Myosarcoma

Angiosarcoma

Lymphosarcoma

The general principles of treatment should be governed by the complementary relationship between surgery and irradiation. Radium is of special value because of its technical flexibility. Implantation alone may be used in benign and malignant tumors of limited volume, but it is only occasionally to be recommended for mixed tumors. It may also be employed post-operatively for benign tumors, but its action is too localized for use following excision of a malignant growth. It may supplement external irradiation and finally may be useful for local recurrences.

Intracavitary irradiation by radium tubes may be used in association with external irradiation for salivary gland tumors involving the nasal or nasopharyngeal cavity or the external auditory canal or with surgery when deep invasion has taken place.

Surface application of radium is rarely indicated. Teleradium, alone or in combination with other forms of therapy, is indicated for malignant tumors.

SYDNEY J. HAWLEY, M.D.

Primary Carcinoma of the Lung: Review of Thirty Proven Cases. Lester M. J. Freedman, Harold W. Jacox, and Reuben G. Alley. *Pennsylvania M. J.* 47: 455-459, February 1944.

Forty-five cases of lung cancer registered in the Tumor Clinic (Western Pennsylvania Hospital) from 1936 to 1942 were reviewed for evaluation of diagnostic procedures and therapeutic results. This number represented about 2 per cent of all malignant neoplasms seen in the clinic. Thirty of the cases were proved by biopsy or postmortem examination. In this series there were 23 males and 7 females; the youngest patient was 32 and the oldest 77 years of age. Most of the patients were in the fifth and sixth decades. Cough, chest pain, and dyspnea were the symptoms most commonly seen. Weight loss, weakness, sweats, clubbed fingers, and hoarseness were also of fairly common occurrence.

The authors state that, "there are no roentgen findings pathognomonic of primary lung carcinoma." Any pathological condition that causes obstruction or irritation may produce the changes seen on the film. Enlarged hilar nodes, peribronchial infiltration, and atelectasis are the most common findings. In 30 per cent of the series reported a parenchymal mass was the predominant feature. Bronchoscopy is the chief diagnostic procedure, as 60 to 75 per cent of lung carcinomas involve the stem bronchi and hilar regions.

Aspiration biopsies were done in three cases in this series and a sufficient amount of tissue was obtained to make a positive diagnosis of carcinoma in all of them. High-voltage roentgen therapy was given in 11 cases, but while symptomatic relief was generally obtained for a time, the authors do not believe that life was prolonged to any degree. In the 19 untreated cases the average duration of life after admission was 1.4 months.

JOSEPH T. DANZER, M.D.

Regression of Bone Metastases from Breast Cancer after Ovarian Sterilization. Max Ritvo and Oscar S. Peterson, Jr. *Am. J. Roentgenol.* 51: 220-228, February 1944.

The value of roentgen ovarian sterilization in the treatment of bone metastases from breast cancer is emphasized by the report of a series of cases from the Pondville Hospital (Massachusetts Department of Health). In properly selected cases, there is usually prompt and effective relief of pain. The lesions in the bones regress partially and in some instances entirely reossify. There is great improvement in the patient's general condition, with increased appetite and gain in weight. The mental status also improves. The question as to whether this form of treatment results in prolongation of life is still in doubt. It is the authors' belief that there has been unquestionable prolongation of life in some instances, while in others there has apparently been no appreciable improvement in this respect.

The total dosage employed is usually 2,000 to 3,600 r, varying with the size of the patient. Two to four fields, each measuring 15 X 15 cm., are used over the lower portions of the abdomen and lower back. One field is exposed daily in rotation and the customary single dose

is 200 r, although it may safely be increased to 250 or 300 r. With the larger dosages a permanent sterilization usually results.

The general consensus of opinion is that about one-third or more of the cases treated may be expected to benefit from this form of treatment. There are no contraindications to ovarian sterilization, and it may be used whenever there is any reasonable hope of benefit. Eight case reports are included to illustrate the value of the procedure. Routine roentgen sterilization of all patients with cancer of the breast is not advocated, the treatment being recommended when osseous metastases have been demonstrated roentgenographically.

L. W. PAUL, M.D.

Carcinoma of the Cervix Coincident with Pregnancy. Charles R. Maino and Robert D. Mussey. *Am. J. Obst. & Gynec.* 47: 229-244, February 1944.

Of 3,570 women with cervical carcinoma seen at the Mayo Clinic from July 1, 1909, to Feb. 28, 1941, 26 or 0.7 per cent were pregnant. The youngest patient of this small series was twenty-five years of age; the oldest was forty-one. The average time at which the carcinoma was found was the twenty-fourth week of pregnancy. In only one instance did carcinoma occur in a first pregnancy.

The symptoms of cervical carcinoma in the pregnant woman are those of the disease occurring independently, plus the signs of pregnancy. Vaginal hemorrhage is the most usual symptom. A biopsy and a pelvic examination should be done in every patient suspected of having a malignant lesion of the cervix.

Treatment depends upon two factors: the viability of the fetus and the operability of the lesion. *When the fetus is viable*, cesarean section is done; if the lesion is inoperable, irradiation follows; if the lesion is operable, a total abdominal hysterectomy is performed with postoperative irradiation. *When the fetus is not viable* and the lesion permits operation, a total hysterectomy is followed by irradiation; if the lesion is inoperable, sufficient irradiation is employed for treatment of the carcinoma and abortion generally follows.

In cases in which the lesion is operable, total abdominal hysterectomy has produced the best results. In 57 per cent of the cases in which this procedure was employed, the patient was free of recurrence five years later. It is difficult to say how greatly the prognosis is improved by postoperative irradiation, as the results vary. In only 2 operable cases was irradiation used alone; both terminated fatally.

The use of irradiation to control the growth of carcinoma until the fetus becomes viable is not without serious risk to both mother and child. According to the literature, abortion occurs in 24 per cent of cases so treated; in about 24 per cent of the remainder the offspring are defective, about half of this number being microcephalic idiots.

The outlook in this series of cases appeared to be at least as favorable as in cervical carcinoma unassociated with pregnancy. Five-year results were available in 20 cases. Six patients were living ten to twenty-three years after treatment; 14 were dead, 13 as a result of extension of the malignant lesion.

Whether the progress of carcinoma is stimulated, retarded, or unaffected by the coexistent pregnancy is a matter of dispute. The cause of the rapid acceleration of growth observed in some instances is not known.

STEPHEN N. TAGER, M.D.

NON-NEOPLASTIC DISEASE

Effect of Roentgen Rays on the Joint Effusions in Certain Nonspecific Articular Lesions in Humans, and on the Normal Joints of Dogs: Preliminary Report. Thomas Horwitz and Melvin A. Dillman. *Am. J. Roentgenol.* 51: 186-201, February 1944.

Roentgen therapy was utilized in the treatment of 6 patients suffering with chronic non-specific synovitis with effusion in the knee joint. In 3 patients both joints were treated and in the remaining 3 only single joints. Two fields were employed, the inner and outer surfaces of the knee, and treatments were given usually at weekly intervals. The total dosages employed varied from case to case but in most instances were between 1,300 and 1,500 r total to each field, the individual doses varying from 198 to 215 r. In 4 patients a second course of therapy was given after an interval of six to ten weeks. In one patient a slight erythema was observed after the dose had reached 1,296 r, and in this case no improvement in the effusion occurred. In the remaining 5 patients (8 knee joints) definite improvement was observed. In 6 joints the effusion disappeared; in 4 there was some residual synovial thickening. In one instance there was only partial diminution in the severity of the effusion following the roentgen therapy, but a complete recovery followed a biopsy of the synovial membrane.

In order to determine the effect of roentgen therapy to the normal joint, experimental studies were carried out on 6 dogs. The left knee joints were treated, and the opposite joints were used as an untreated control. The largest total dose to any one joint amounted to 8,000 r, given over a period of three and a half months. None of the dogs gave evidence of any discomfort in the treated joints, and only one showed some loss of fur and superficial skin ulceration. No changes in the roentgenograms of the treated and control joints were observed. Gross examinations and histopathologic studies of the treated and control joints in 4 of the dogs revealed no abnormal changes in any of the specimens and no differences between the treated and control joints. Two of the dogs are still being observed in order to determine if there is any delayed roentgen-ray effect.

Reviewing their clinical material, the authors believe that roentgen therapy has been found beneficial in the control of the joint effusion and its attendant discomfort in certain non-specific synovial lesions, but that the residual synovial thickening, with residual pain in one patient, suggests that the progress and ultimate course of the underlying pathologic process is not favorably affected.

L. W. PAUL, M.D.

Rationale and Results of Roentgen Treatment of the Adrenal Glands in Angina Pectoris. W. Raab and A. B. Soule, Jr. *Am. J. Roentgenol.* 51: 364-377, March 1944.

The theory advanced by Raab that anginal attacks are brought about by the acutely anoxiating effects of adrenalin discharges upon a heart muscle whose coronary arteries are sclerotic and thus unfit for adequate compensatory dilatation is based upon the following facts: (1) Adrenalin exerts a specific, intensely anoxiating effect upon the heart muscle. (2) Adrenalin is physiologically discharged from the adrenal glands into the blood stream under the influence of physical

exercise, emotions, and cold, under the very conditions which usually elicit anginal pain. (3) The heart muscle possesses a greater tendency than other tissues to accumulate circulating excess amounts of adrenalin. (4) During physical exercise or exposure to cold the adrenalin content of the heart muscle increases while that of the adrenal glands diminishes. (5) Injection of adrenalin is likely to produce anginal symptoms in persons with coronary sclerosis. (6) Abnormally intense discharges of adrenalin into the blood stream during physical exercise were observed in all of 12 patients suffering from angina pectoris. (7) The electrocardiographic changes which occur during anginal attacks are practically identical with those following the administration of adrenalin. (8) Patients with tumors of the adrenal medulla often suffer from anginal attacks. (9) Conditions which are known to increase the secretion of adrenalin, such as tobacco smoking or overdosage of insulin or breathing of low oxygen concentrations, are likely to elicit anginal symptoms.

Raab previously irradiated the adrenal glands in 100 European patients with angina pectoris (*Ann. Int. Med.* 14: 688, 1940). Seventy-six of these patients were either entirely freed of their complaints or at least improved for an average period of twelve and a half months. The present report is of 42 typical angina cases similarly treated in America. Two hundred roentgens (measured on the skin) were administered at each treatment. Six single treatments were given on consecutive days, three to the left upper quadrant of the abdomen posteriorly and three to the right, the left and right sides being treated on alternate days. Each area received 600 r as a total dose per series. When the treatment was repeated, the minimum interval between two successive series was six to eight weeks. In the improved cases the average number of series of treatments given was 1.6. Seventy-four per cent of those treated were either completely freed of their anginal complaints or at least improved for periods ranging between five and forty-five months with an average of two years up to the time of the report. Nine of the 11 unimproved patients had not received three series of roentgen treatments and thus cannot be considered as definite failures. No untoward side effects were noted. There is no evidence that irradiation of the adrenal region caused damage to the basic normal function of the glands. The essential effect of the treatment seems to consist in the abolition of the abnormally intense adrenalin discharges on effort, etc., through suppression of an existing state of abnormal irritability of the nervous mechanism of adrenal medullary secretion. Death occurred in 7 of the 42 patients. Three died suddenly during a state of clinical improvement, apparently from coronary occlusion. Three others died during relapses of their anginal condition after temporary improvement. One patient died from pneumonia.

CLARENCE E. WEAVER, M.D.

Tubercular Adenopathy in Young Children. Ira I. Kaplan. *Arch. Pediat.* 61: 119-122, March 1944.

The greatest incidence of tuberculous adenopathy is in the twenty- to thirty-year age group, but a certain number of young children are affected, also. Often there is no association with pulmonary tuberculosis. The infection in 90 per cent of cases is bovine in origin.

Some years ago surgery was frequently resorted to

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for tuberculous adenopathy, but radiation therapy has now come to be the treatment of choice in most clinics. Improvement is slow, but results are usually permanent and recurrence is rare. Scarring is less with radiation than with surgery. Large masses are often replaced by minute, painless, readily movable nodules, surrounded by loose elastic cellular tissue, which later undergoes still further regressive changes. Not to be overlooked, also, is the analgesic effect of x-rays here as in other inflammatory conditions.

In the author's series of 22 children, the total dosage was usually from 600 to 900 r; 100 to 150 r were given at a sitting. Medium voltage was employed in most instances; only occasionally was high voltage used, when the node involvement appeared to be more deeply seated.

PERCY J. DELANO, M.D.

Koilonychia and Polycythaemia Vera. A. J. Glazebrook. *Edinburgh M. J.* 51: 65-69, February 1944.

The author reports a case of koilonychia—so-called "spoon nails"—associated with polycythemia vera.

Roentgen irradiation of the entire body reduced the red cell count and resulted in a large increase in the serum iron content. Healing of the nails occurred, but this the author attributes to the improved serum iron content rather than a direct action of the rays on the epithelial tissues, since the dosage was small.

Ringworm of the Scalp. Successful Use of Roentgen Rays to Epilate Local Areas of Infection. George M. Lewis and Mary E. Hopper. *Arch. Dermat. & Syph.* 49: 107-108, February 1944.

The extent of infection in ringworm of the scalp can be accurately shown by examination under filtered ultraviolet light. When examined under such a light the hairs infected with fungi are fluorescent. For treatment most dermatologic departments use the five-exposure epilation method. If the infected area has been clearly delineated by this method, the epilation dose can be restricted to the region involved.

JOSEPH T. DANZER, M.D.

EXPERIMENTAL STUDIES

Role of Inflammation in the Induction of Cancer by X-Rays. H. Burrows and J. R. Clarkson. *Brit. J. Radiol.* 16: 381-382, December 1943.

Foci of infection were produced in the groins of rabbits by the injection of silica in oleic acid and kaolin in water. When inflammation developed, the areas were treated with 600 r (250 kv., 4 ma., 0.5 mm. Cu filter). In 8 of 9 rabbits so treated, sarcoma developed in the involved area. The earliest appeared twenty-two months after irradiation. In 2 of the animals there were no metastases, while 6 had metastases at the time of death.

A second series was treated with 2,000 r, 600 r, and 250 r (150 kv. and 0.3 mm. Cu filter). Other rabbits were infected with irritants but no irradiation was given. Of 8 rabbits receiving 2,000 r or 600 r sarcoma developed in 5, the earliest appearing in twenty-two months. No tumors appeared in the group injected but not irradiated. In another control group of 12 irradiated animals, without the inflammatory process, 2 showed tumors near but not in the irradiated area. These tumors were not of the same histologic type as those seen in the rabbits with inflammation.

Similar experiments were tried on guinea-pigs but only a few survived. None of these showed tumors.

SYDNEY J. HAWLEY, M.D.

Spatial Distribution in Irradiated Tissue and Its Relation to Biological Effects. D. E. Lea. *Brit. J. Radiol.* 16: 338-339, November 1943.

Energy is dissipated in tissue irradiated by x-rays, neutrons, or radioactive radiations mainly by ionization and excitation. At present excitation is thought to be of little or no importance. To understand the direct effect of irradiation, then, it is necessary to know the amount of ionization produced by one r and its manner of distribution.

Working with chromosomal aberrations in irradiated microspores of *Tradescantia*, it was found that if the microspores were irradiated in the early stages of mitosis breaks were produced in the chromosome threads.

One "roentgen" of neutrons administered to a cell results in 1.56×10^{-3} protons crossing each area of one square micron. The area of the chromosomes in one grain is approximately known. From this it is deduced that with a dose of 8 r the average number of occasions on which a proton traverses a chromosome is one per pollen grain. This is also the dose required experimentally to get an average break of one chromosome per pollen grain. Unless this is regarded as coincidence, it must be concluded that a chromosome is broken each time a proton traverses it.

When medium length x-rays are used, twenty times as many ionizing particles traverse chromosomes, yet fewer breaks are produced. It follows that this lesser efficiency is due to the small number of ionizations produced by an electron per square micron. The number of ions per micron varies with the length of the path of the electron, being smaller at the beginning and larger at the end. The length of the effective terminal path of the electron is 0.25 micron. We can now predict that the most effective wave length is 4 Angstroms. Experimental trials agreed satisfactorily with this.

SYDNEY J. HAWLEY, M.D.

Investigations Into the Degree of Scattered Radiation Received by X-Ray Workers During Routine Diagnostic Examinations in a Military Hospital Department. J. A. C. Fleming. *Brit. J. Radiol.* 16: 367-370, December 1943.

By ionization measurements tests were made, under conditions as near as possible to working conditions under a heavy schedule, of the amount of scattered radiation received by unprotected workers. If they stayed two and a half feet away from the direct beam during both fluoroscopy and radiography they received less than the maximum tolerance dose of 10^{-3} r per second. If films are made during fluoroscopic examination, the unprotected worker should be five feet away from the direct beam.

SYDNEY J. HAWLEY, M.D.

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with the self-styled radiologist who habitually employed abstract film study in diagnosis. He constantly impressed upon the referring members of the staff the necessity of including important data in their requisitions for roentgen studies. We are convinced of the fundamental importance of this attitude.

Doctor Hickey insisted that members of his staff perfect themselves in radiographic technic and that they become competent to perform any examination as well as or better than members of the technical staff. This included film processing as well as exposure technic. We are likewise impressed with the importance of acquiring such technical skill, for the radiologist in the Army may find himself with an untrained staff and, unless he is thoroughly familiar with the technical aspects of his work, the preparation of a satisfactory exposure technic and the direction of the many other technical procedures in an x-ray department may be accomplished only with great difficulty. The specialist in radiology can attain the highest efficiency only if he is himself an accomplished technician as well as a diagnostician.

In 1917 Doctor Hickey was among the first to volunteer for military service. He went abroad with the Harper Unit, but shortly thereafter was assigned to duty as roentgenologic consultant for the American Expeditionary Forces. Here, in both an advisory and administrative capacity, he was most successful. He was effective in liaison work and possessed to an unusual degree the ability to obtain close co-operation from his fellow officers and those members of the British and French Medical Corps with whom he was associated.

As stated previously, one of Doctor Hickey's outstanding characteristics was his talent for teaching, and he was at his best in clinical conferences and in kindly, stimulating talks with students. Having a

wide knowledge of the entire field of radiology, he had the rare faculty of transmitting this knowledge to those who sought instruction. His ability was early recognized, for he became the Professor of Roentgenology of the Detroit College of Medicine and Surgery in 1909, which position he held until 1922. After the World War he re-entered private practice, but in 1922 was appointed Professor of Roentgenology in the University of Michigan School of Medicine. Here he was afforded an unusual opportunity in instruction and organization, and he more than lived up to all that was expected of him. He planned, organized, and watched grow to maturity one of the outstanding departments of radiology in this country.

Doctor Hickey was tolerant of all men and envied none. Much has been written extolling his virtues, his capacity for industry, and his extraordinary ability for organization. We have tangible evidence of his ability along these lines in his many writings and in the excellent Department of Radiology that he organized and directed. Perhaps one of his most important contributions to medical education in general, and radiology in particular, was his work with the *American Journal of Roentgenology*, which he founded, and which he edited for many years.

We, as representatives of the Armed Services, wish particularly to pay tribute to Doctor Hickey, who, with entire disregard for self-interest, comfort, and financial sacrifice, enlisted early in the "Great War," although already at an age well beyond that of most men entering the services. He served with distinction and, with a few others, did much to establish the present high standards of radiology in the United States Army. Radiology in America, and in the world as well, is fortunate in having as one of its pioneers such an outstanding physician.

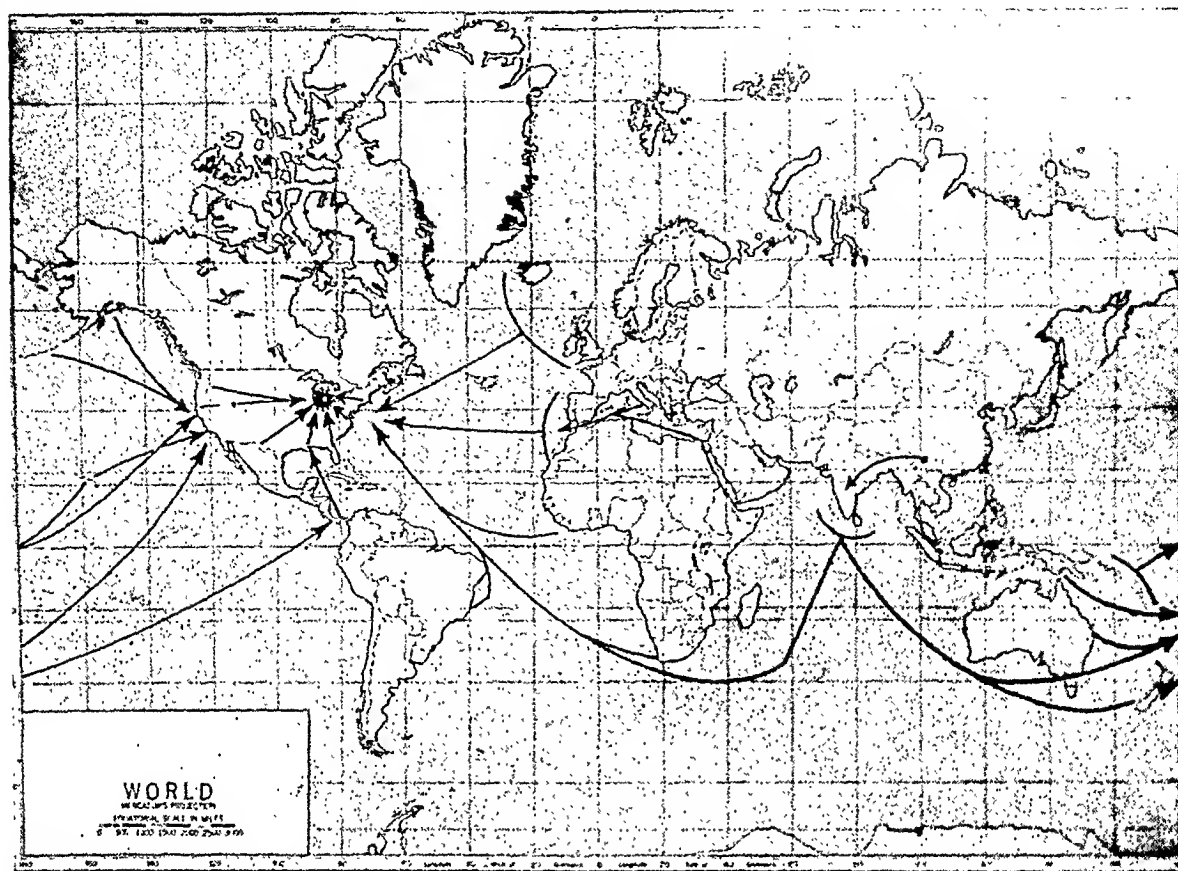


Fig. 1. Map showing in a general way the areas throughout the world from which patients have been received.

THE FUNCTION OF THE MEDICAL DEPARTMENT OF THE ARMY

The function of the Medical Department of the Army is to preserve the health of the personnel, to treat those who are ill, to rectify as far as possible damage from accidents, injuries of all kinds, including those incurred in the face of the enemy, and to return as many men as possible to active service. When return to active duty is not possible, it is then the function of the Medical Department to place each man in the best possible physical condition before he is released from the Army or, in some instances, turned over to the Veterans' Facility for further medical care.

In battle the Medical Department begins to function very close to the front line, where injuries are treated and the soldier is returned to duty when possible. More serious injuries may require evacuation to more adequate medical installations, where

further treatment can be administered. Again, as many as possible are returned to active duty, while those with still more serious injuries or diseases are again evacuated to medical installations farther from the fighting front, where definitive treatment may be instituted. Those who can return to active duty within a reasonable period of time do so. Where this is not possible, the patients are further evacuated, and some of those suffering from the more complicated diseases and injuries, those requiring special treatment or treatment over long periods of time, eventually arrive at one of the named general hospitals within the continental limits of the United States.

THE NAMED GENERAL HOSPITALS

The named general hospitals are fixed installations completely equipped and adequately staffed by specialists. In them

is provided medical care of the highest type available in the Army, comparing favorably with any private institution in America. General hospital patients who can return to duty after suitable treatment do so, regardless of the length of time required to restore them to health. Others, who cannot be returned to duty, can be discharged only after they have reached the maximum improvement possible in a hospital of this type. Certain chronic diseases and disabilities resulting from injuries are such that they reach a level beyond which improvement will not take place in a general hospital. Such patients

The patients entering our institution at the present time come from almost all parts of the world. Some are transferred from Station Hospitals and other hospitals near our institution. Others are transferred from various installations throughout the United States, either because of our special facilities for treatment or in order that the patients may be hospitalized as near home as possible, the latter being an established Army policy. Many are battle casualties coming from long distances. The various parts of the world from which we receive patients are in a general way indicated by Figure 1. Because of the many regions

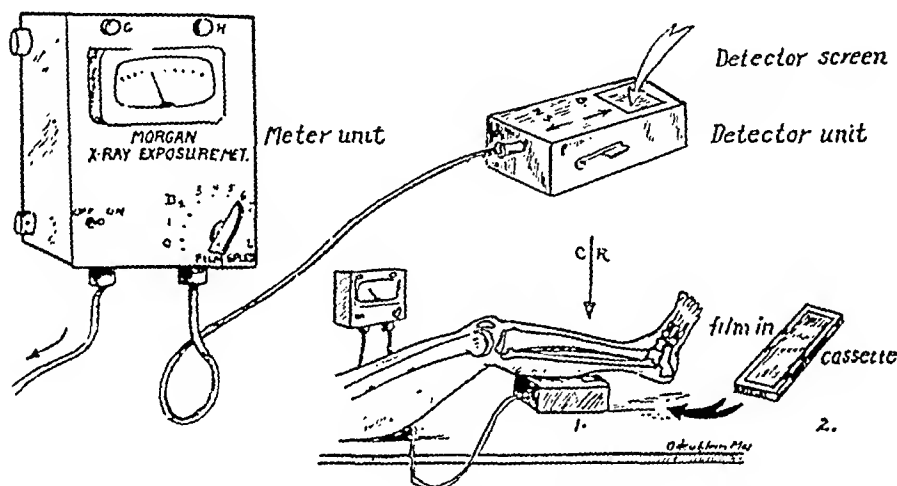


Fig. 2. Morgan meter: meter and detector units and method of use. Drawings by Major Heublein.

are discharged to the Veterans' Facility for further care or, in some instances, are retired on pension.

The services in the general hospitals are highly specialized, and certain institutions are, in addition, equipped and staffed in order that treatment not available in the average general hospital may be provided. These specially equipped hospitals are designated as centers for the study and treatment of specific conditions. The Percy Jones General Hospital has been designated as an amputation center, a neurosurgical center, a center for chest surgery, for roentgen therapy, and for the study of malaria. The importance and value of centers of the above type are evident in the results obtained.

from which these patients come, disease conditions are being seen which are not ordinarily encountered in the civilian hospitals of the United States.

X-RAY DEPARTMENT OF THE PERCY JONES GENERAL HOSPITAL

It was the good fortune of one of us (J. C. B.) to be given the responsibility of planning and equipping the X-Ray Department of the Percy Jones General Hospital. The Commanding Officer, then Colonel Norman T. Kirk, now the Surgeon General of the Army, exhibited a full understanding of the requirements, responsibilities, and value of the x-ray service. He insisted that the space allotted be adequate, that the equipment be of the best

and sufficient to meet all of the needs of a hospital of this type. We have, as a result, a department that is centrally located, completely equipped, and well planned, with approximately 6,000 square feet of floor space.

In addition to the usual equipment of a hospital of this type, we have quick-changeover switches and spot-film tunnels, for compression exposures in gastro-intestinal examinations, with two of the four 200-ma., 100-kv. combination radiographic and fluoroscopic machines. There are equipment for myelography, an attachment for the field unit for encephalography, modifications in the Bucky diaphragms permitting serial radiography in examinations of the gastro-intestinal tract, and an experimental model of the Morgan meter for predetermination of the proper x-ray exposure.

We have a completely equipped roentgen therapy division with a 220-kv. oil-cooled machine together with a superficial water-cooled unit with a capacity up to 135 kv. The cystoscopic division is separate from the main department, being located near the operating pavilion on the sixth floor of the hospital. A conveniently located darkroom provides facilities for processing of films made during cystoscopy or in the operating rooms. There are two cystoscopic tables with separate tubes but with a single transformer and control, there being a high-tension switch which permits the use of either table.

THE MORGAN METER

We have been fortunate in having an opportunity to study the Morgan exposure meter in this hospital. This meter takes advantage of the fact that all properly exposed x-ray films are of an average density of 0.9 in the diagnostic range as read on a densitometer. This is true whether the examination be of the spine, skull, chest, extremity, or of any other part of the body.

This meter, shown in Figure 2, consists of two parts, a detector unit and a meter unit. The detector is used prior to ex-



Fig. 3. Exposure made with lower leg in cast. Morgan meter employed to determine exposure time.

posure of the film, being placed under the part which is to be examined and exposed, using any suitable kilovoltage. The proper exposure time is indicated on the dial of the meter unit. After the initial exposure, the detector unit is replaced by a film, which is exposed in the same manner and with the factors already used, but with the previously determined exposure time.

Many simple and complicated examinations have been made using this device, and good results have been obtained. All instances of failure have been due to improper positioning of the detector unit. Excellent results have been obtained with amputation stumps, in cases where there has been considerable demineralization and in those cases where the proper exposure could not be determined by measurement because of bone condensation changes or calcification in the soft tissues. We have found the meter especially valuable in obtaining films of brilliance and clarity in orthopedic cases where extremity films must be made through plaster, as is shown in Figure 3. It has been observed that in

follow-up examinations much more uniform exposures are obtained when the meter is used than when reliance is placed on measurement technics, often employed by different members of our technical staff.

CASE 1: A 23-year-old white private, first class, began to suffer from pain in his left leg two years prior to his entrance into this hospital. Six months before admission a tumor was found in the femur at Letterman General Hospital. This is shown in Figure 4. The biopsy diagnosis was atypical tel-

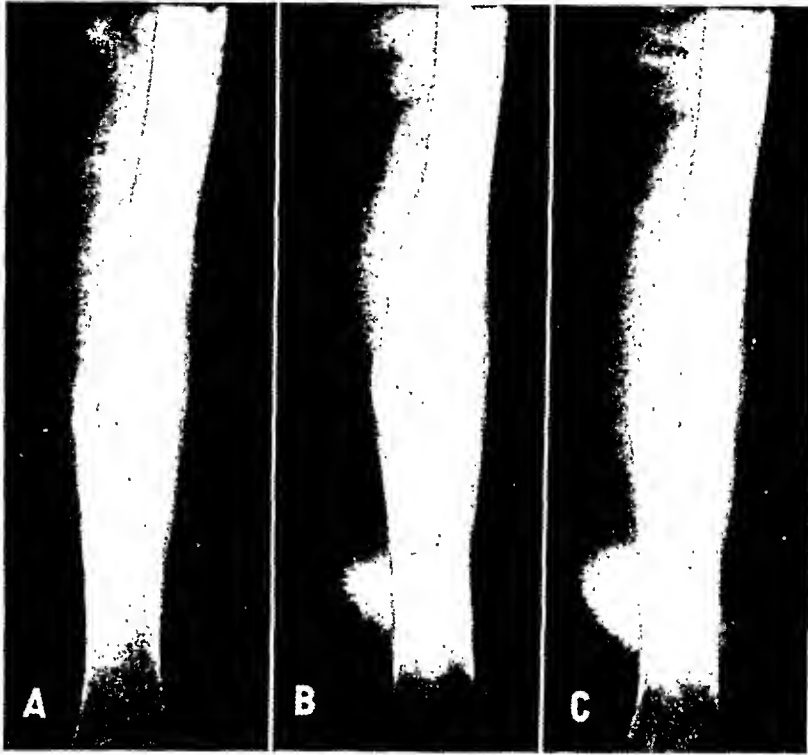


Fig. 4. Case 1: Exposure times determined with the Morgan meter. A. 50 kv., 240 ma. B. 70 kv., 45 ma. C. 80 kv., 24 ma. There is no significant difference in detail in the three films.

We have not only proved to our own satisfaction that film density remains constant over a wide range of kilovoltages, as is shown in Figure 4, but we have also been able to disprove to our own satisfaction the theory that high filtration improves contrast by making the incident ray more homogeneous. The latter is shown in Figure 5. Suffice it to say that we are convinced the Morgan meter is a great asset in the field of modern radiography and that the radiologist can look forward with confidence to its future usefulness in the diagnostic field, especially for solving new and difficult problems, and for improving and stabilizing standard technics.

The history in the case shown in Figure 4 is of interest.

angiectatic sarcoma. Operation showed the medullary canal to be filled with firm tumor tissue. The tumor was found to extend into the soft tissues and roentgen therapy was given to eight fields, the total dosage to each field being 1,200 r. The leg became asymptomatic. The slides were reviewed by the Army Medical Museum, where a diagnosis of ossifying angioma of bone was made. Another pathologist made a diagnosis of osteoid osteoma. The pain recurred and the patient was transferred to this hospital, where re-examination showed bone changes that were considered characteristic of those resulting from a malignant tumor. Subjective improvement followed irradiation through two fields, the total dosage being 1,800 r to each field. Amputation was done Feb. 24, 1944. The specimen showed an infiltrating malignant tumor which was considered by our pathologist to be characteristic of metastatic adenocarcinoma, the primary site of which could not be determined. A careful review of the case has failed, however, to show evidence of any tumor aside from the one in the femur.

WEEKLY CONFERENCES

Weekly conferences are held by the medical and surgical services, in which our staff takes part, presenting the x-ray findings in the cases under consideration. In

When films are being interpreted daily, the interesting cases are listed for our Saturday meeting. During the middle of the week the program is made up, usually consisting of approximately 6 cases. These

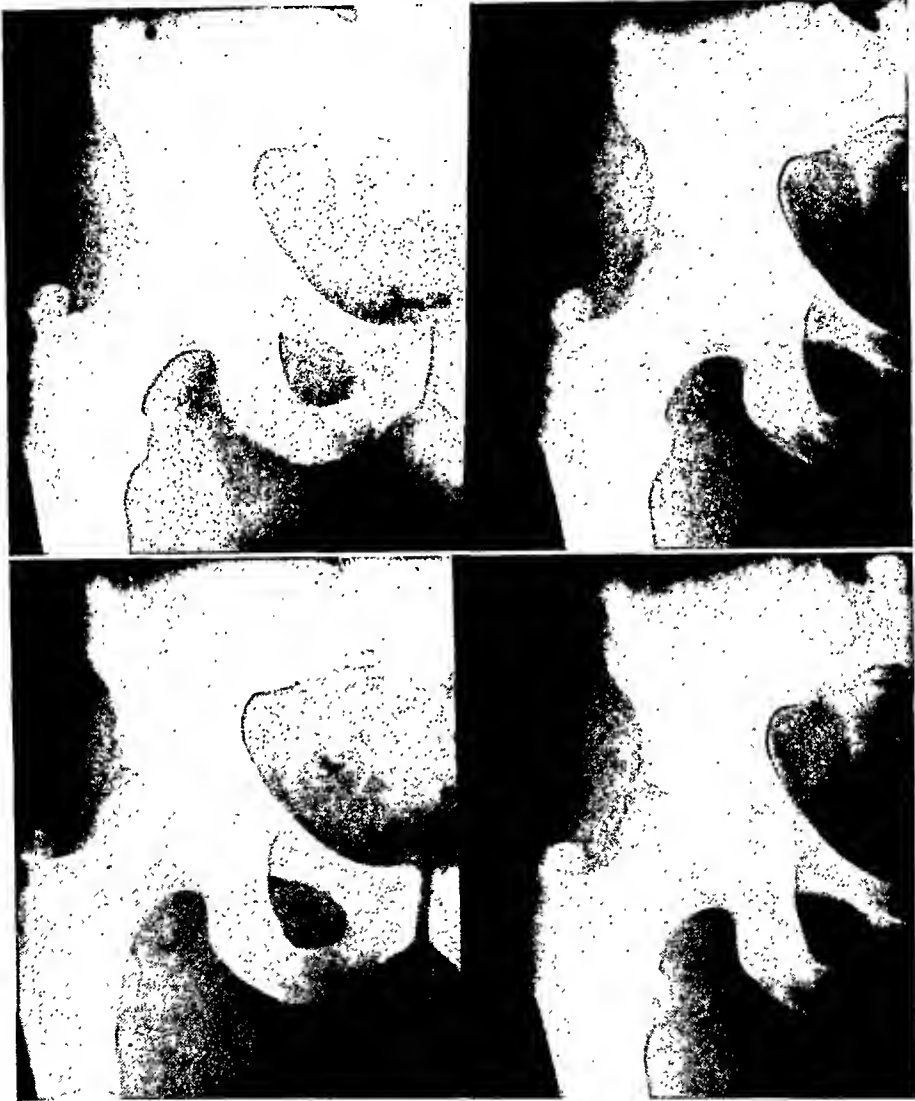


Fig. 5. Four exposures of the right side of the pelvis, all of the same subject, made with constant kilovoltage but with filters varying from 1 to 4 mm. of aluminum, the exposure time being determined by the Morgan meter. No significant difference in detail could be noted. The increase in filtration required a very definite increase in exposure time, however.

addition there is an X-Ray Conference each Saturday afternoon from 1:00 to 2:00. This has proved a most satisfactory conference for it serves as a forum, familiarizing all members of the staff with the interesting cases under treatment in the many departments of the hospital.

are of different types, so that various departments of the hospital are represented. The referring ward officer presents the case history briefly, after which the x-ray findings are demonstrated by a member of our staff. There is then a general discussion which is guided by a member of the X-Ray

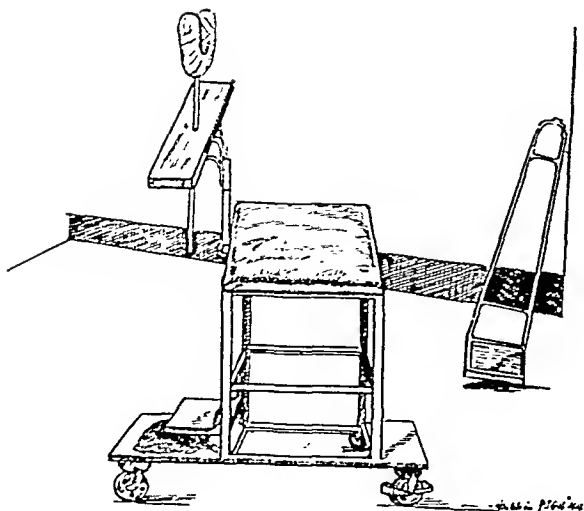


Fig. 6. Chair used in pneumoencephalography. The cassette-supporting arm used with the field unit is shown on the right. Drawing by Major Heublein.

Department, pertinent questions being asked in order to bring out points of importance and to encourage younger members of the hospital staff to take part. We have found the greatest interest in cases in which the diagnosis has not been determined at the time of presentation. Such cases are brought up for discussion at later conferences, with reports of further findings until the diagnosis is determined with certainty.

We are guided entirely, in the time given to the discussion of each case, by the interest of the audience. Seldom are all cases on the program presented, for the discussion is entered into freely by many of those present.

Considerable teaching is carried on in the department at all times, particularly for young physicians who are assigned temporarily to the hospital for instruction, especially in anesthesia and neurosurgery.

An attempt will be made to give an idea of some of the work that goes on in our department. A summary of the incidence of the various diseases in a hospital of this type is of little value, since the patients are filtered out from large numbers in many other institutions. For example, in the first one hundred upper gastro-intestinal examinations that were done, 59 per cent of the patients from overseas were found to

have duodenal ulcers. This incidence is higher than would be expected in civilian practice; it is due to the accurate work that is being done in other Army installations in this country and abroad, only those cases with positive findings being transferred to us.

We have selected for consideration some conditions that have proved to be of most importance in causing disability in soldiers, together with a few of the rarer lesions that have been observed.

THE CENTRAL NERVOUS SYSTEM

Encephalography is widely used in this hospital in the study of cerebral disorders. This is particularly true in cases of cerebral trauma, including concussion where there is no external evidence of damage to the structures overlying the brain. It is also used in patients with fractures and defects in the skull resulting from gunshot wounds, to determine whether or not the brain has been affected, and the extent of the damage.

The neuropsychiatric department makes use of encephalography in many cases and has been rewarded by finding organic brain damage of various types, together with developmental anomalies, in cases previously diagnosed as psychoneuroses, the organic changes in the central nervous system apparently accounting for the abnormal psychogenic manifestations. This department also has been alert in its search for other organic disease in patients sent here as psychoneurotics, and a significant percentage of lesions, such as duodenal ulcers and abnormalities of the urinary tract and chest, have been discovered that could well explain the symptoms.

We use a special chair in encephalography, illustrated in Figure 6. This chair was described by one of us (J. C. B.) elsewhere (1) and has been most satisfactory. It is readily adjustable to a patient of any size, from a very young child to a large adult. It can be moved easily from one part of the department to another and is the same height as the x-ray table, thus facilitating shifting of the patient from the

chair to the table in order that films may be made in the conventional manner.

With the above apparatus, encephalography can be done with great ease and rapidity, the average examination taking approximately fifteen minutes from the time the needle is inserted until all of the films have been made. A special cassette-holding arm has been made for use in combination with the Army field unit. It is illustrated in Figure 7 and is valuable in encephalography where lateral and postero-anterior films are routinely made with the patient upright. A stationary removable grid is a part of this apparatus and the films secured are of excellent quality.

The lumbar puncture is done with the patient sitting in the chair. After the first 30 c.c. of oxygen have been injected, a lateral view of the skull is made, with the use of the field unit and cassette-holding arm above described. Double the usual exposure is given in order that the film may be examined during processing, to ascertain whether or not the ventricles are filling and to determine their approximate size. This is generally done about one minute after the film is placed in the developer. The injection of oxygen continues in the meantime, in the average case approximately 70 c.c. being used. If there is no indication for injecting a larger amount of gas, the needle is withdrawn, and films are made in the lateral and postero-anterior positions with the patient upright. The chair is wheeled to the side of the table and the patient is shifted to the table and placed in a supine position. A horizontal exposure is then made with the forehead up, using the field unit and cassette-supporting arm. This insures filling of the anterior portions of the third and lateral ventricles. Stereoscopic films are next made in the antero-posterior position with the regular stationary unit. The patient is then turned to the prone position with the forehead down, and an exposure is made with a horizontal ray, again with the mobile unit. This insures filling of the posterior parts of the third and lateral ventricles. Stereoscopic films are next made with the stationary

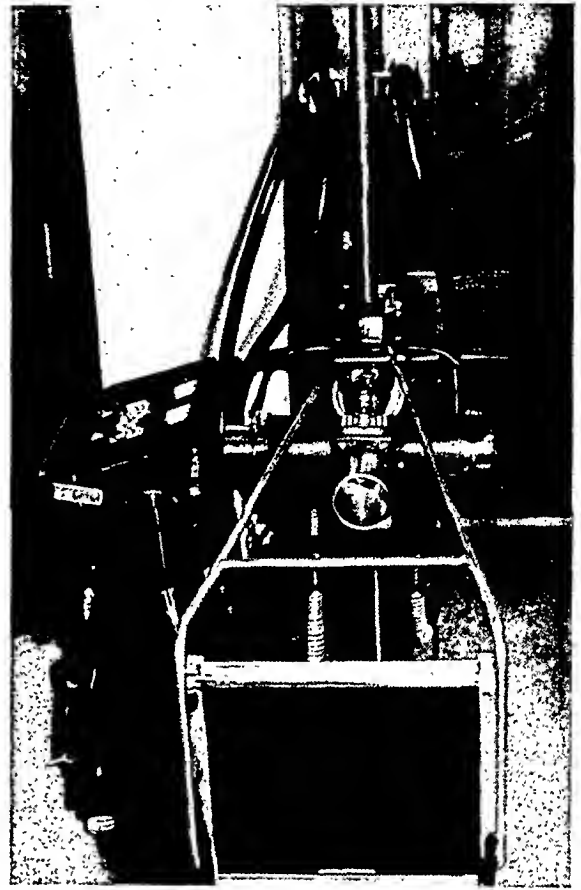


Fig. 7. Cassette-supporting arm used in pneumo-encephalography and in making lateral films in myelography, attached to the Army field unit.

machine, in postero-anterior and right and left lateral positions. This technic has proved to be very satisfactory except in rare instances where special exposures are required.

A small number of brain tumors have been demonstrated, usually by ventriculography. Pituitary tumors have been relatively common, as might be expected in the age group with which we are dealing.

The following are illustrative cases:

CASE 2: A 29-year-old nurse was admitted to Percy Jones General Hospital Dec. 23, 1943, with a history of severe headaches since Nov. 10, 1943, when she was on duty in England. There was definite evidence of increased intracranial pressure. Ventriculography (Fig. 8) showed distortion of the ventricular system, apparently due to a tumor lying close to the midline, protruding slightly more to the right than to the left. It appeared to be primary in the posterior part of the third ventricle or in the immediately surrounding structures. A crani-

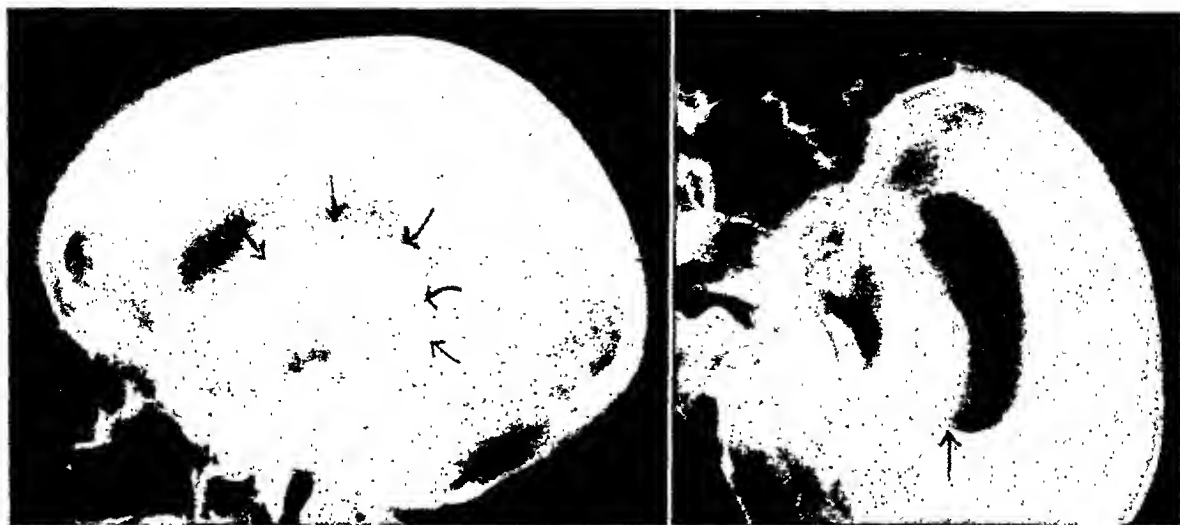


Fig. 8. Case 2: Tumor projecting into the lateral ventricle and blocking the posterior part of the third ventricle, indicated by arrows.



Fig. 9. Case 3: Anteroposterior and postero-anterior views of gas-filled lateral ventricles. Exposure on right is reversed. The deformity of the left lateral ventricle indicates that the encroaching lesion is in the mid or posterior parietal area.

otomy was done Dec. 28, 1943. The right lateral ventricle was entered and was found to be full of blood. A very soft tumor was found that was considered to be characteristic of a glioma. No biopsy was taken because of the patient's condition. She has been given heavy irradiation over four fields but has shown no improvement.

CASE 3: A 35-year-old technical sergeant gave a history of jacksonian convulsions involving the right hand for six years, with progressive weakness of the right hand for a period of one year. Encephalogram-

raphy, (Fig. 9) showed depression of the left lateral ventricle with shift of the midline structures to the right, suggesting a parasagittal meningioma. No cutaneous angiomas were present. On Dec. 22, 1943, craniotomy disclosed a cavernous hemangioma with many vermiform channels crossing through the subarachnoid space. The hemangioma covered an area approximately 3 inches in diameter. One large vein carrying red blood disappeared out of the field in the region of the rolandic fissure. A drawing made at the time of operation is shown in Figure 10.

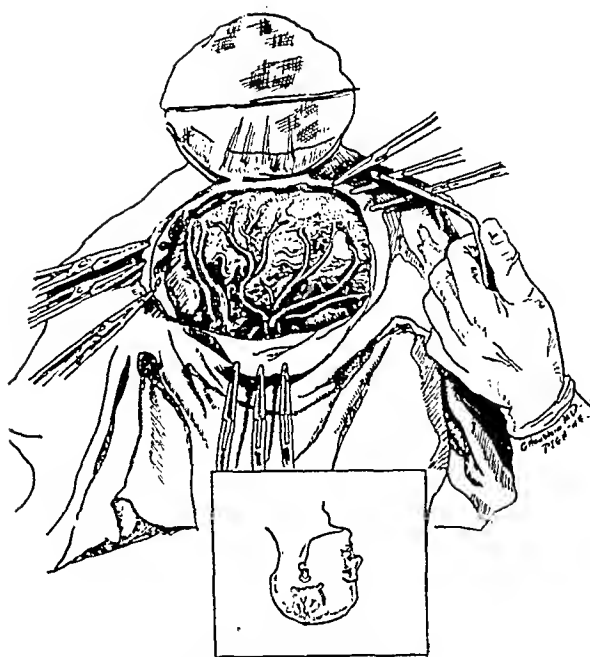


Fig. 10. Case 3: Drawing made at operation showing cavernous hemangioma in left parietal area.

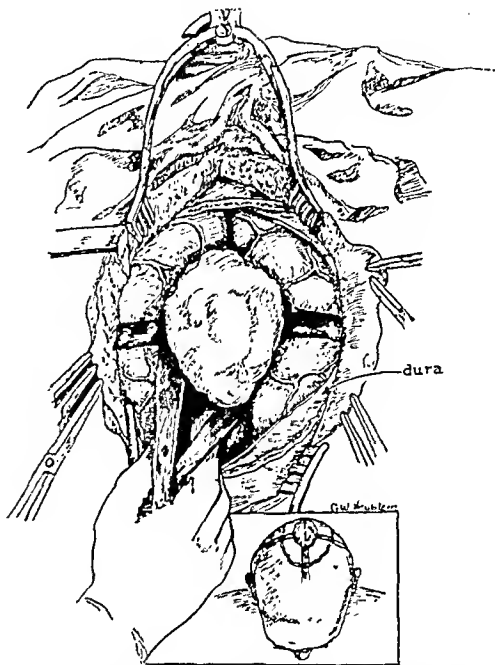


Fig. 11. Case 4: Drawing made at operation showing large meningioma with sarcomatous change.

The lesion was found to be inoperable and the patient was referred for deep x-ray therapy. A total of 2,000 r was given to each of three fields between Jan. 6, 1944, and March 3, 1944, and definite clinical improvement was evident at the time of discharge to a Veterans' Facility.

CASE 4: A 27-year-old private was admitted to Percy Jones General Hospital, July 27, 1943, having first noticed a mass in the occipital area three months prior to admission. It had increased rapidly in size, being approximately half the size of an ordinary orange when first seen here. Six weeks before entrance the patient began to suffer from occipital headache that radiated into the frontal area and he complained of attacks of dizziness aggravated by sudden changes in position. One month before admission the mass was aspirated and cholesterol crystals were said to have been obtained. Physical examination at this hospital showed bilateral nystagmus with bilateral sixth nerve weakness. Moderate papilledema was noted, and there was diminution in the corneal reflexes on both sides. Our x-ray examination, as well as one done before admission, showed a large irregular area of destruction in the region of the torcular. The margins of this area were moth-eaten in appearance and in our report it was stated that the defect suggested bone destruction due to an underlying meningioma, possibly with secondary malignant change. The same diagnosis was also suggested in a report made before the patient was sent to this hospital. At operation a very large meningioma, shown in Figure 11, was found. There was definite invasion of the adjacent bone. Microscopic section showed sarcomatous

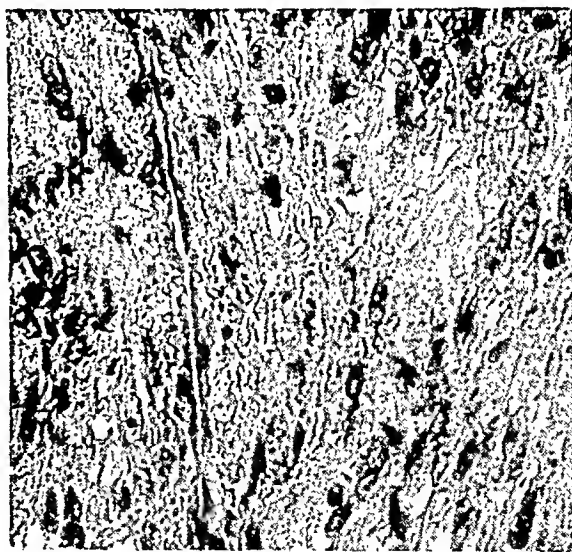


Fig. 12. Case 4: Sarcomatous meningioma. High-power photomicrograph showing spindle-cell morphology and occasional mitoses.

change in the meningioma (Fig. 12). The patient was given heavy radiation between Aug. 23 and Nov. 22, 1943, but died Dec. 13.

Myelography is much in demand, the most frequent indication being symptoms suggesting a herniation of the nucleus pulposus. Many such lesions have been found and removed, with satisfactory post-

operative results in most instances. In one case this procedure was invaluable in confirming the clinical impression of an epidural abscess. The case history and roentgen findings follow:

CASE 5: A 21-year-old corporal gave a history of having a furuncle over the left clavicle Sept. 14, 1943. With conservative treatment drainage took place four days later. The patient did well for one week, when he began to suffer from constipation, dizziness, malaise, and left upper quadrant pain.

was somewhat stormy, but complete recovery took place.

Prior to 1928 the mortality from epidural abscesses was 70 per cent, but present figures indicate that 33.3 per cent of the patients recover completely, 33.3 per cent recover but have residual paralysis, and the remainder die. The staphylococcus is usually the infecting agent, as in our patient.

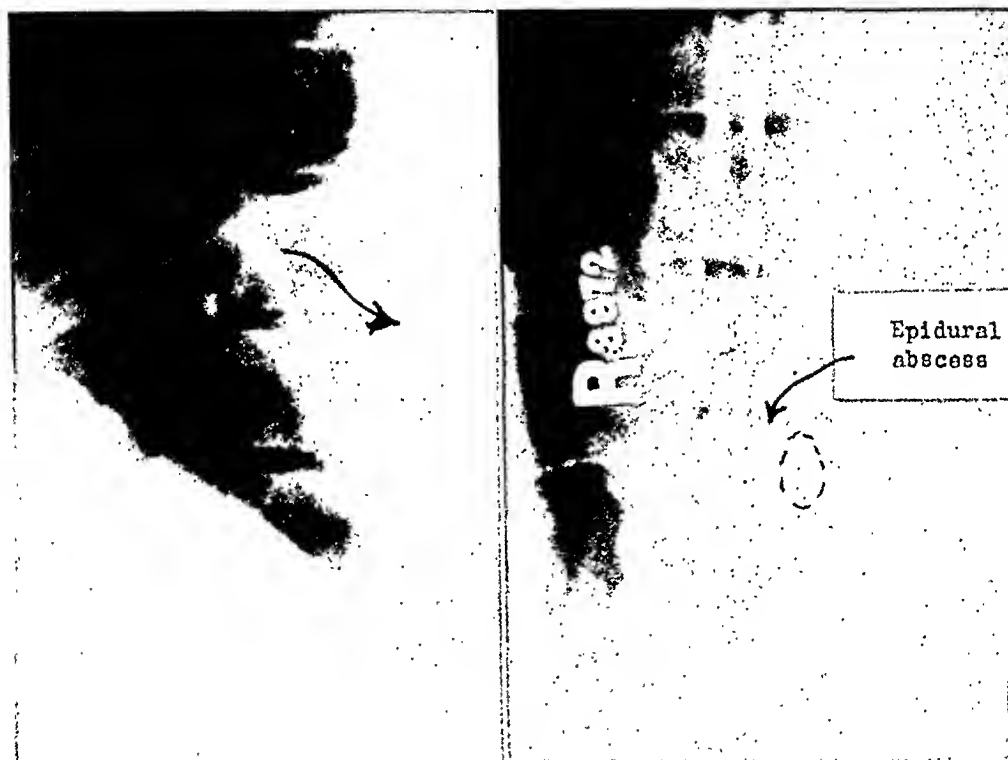


Fig. 13. Case 5. Anteroposterior and lateral views of dorsal spine showing block of subarachnoid space at the level of the eighth thoracic vertebra. The column of opaque material is displaced toward the right in the area indicated by the arrow. Block due to large epidural abscess.

The diagnosis of a perirenal abscess was considered, but subsequent papilledema and stiffness of the neck led to the diagnosis of epidural abscess, which was confirmed by myelography. The spinal fluid showed xanthochromia.

The white count in the spinal fluid was 10,300 and there were 30,000 red blood cells per cubic centimeter. Physical examination showed weakness of the lower extremities. The knee jerks were absent and the ankle jerks hyperactive. Myelography showed a block at the level of the eighth thoracic vertebra, as shown in Figure 13. A laminectomy was done immediately, the field of operation extending from the eighth thoracic vertebra to the second lumbar vertebra. A large epidural abscess was encountered, which was drained. The convalescence

The most important requirement from the radiographic standpoint in satisfactory myelography is an adequate number of films made in the anteroposterior projection, with the column of contrast material passing over each interspace, in any area that may be under suspicion. This insures varying degrees of filling at each interspace. Some lesions are difficult to demonstrate when the column is broad and dense but may be obvious when only a small amount of contrast material is present. Exposures in the lateral projection are also essential.

They are best made with the patient prone, with a horizontal ray. Most satisfactory views of any part of the spinal canal can be secured with the mobile unit and cassette-supporting arm described and illustrated in the discussion of encephalography. The method of examination and type of film obtained are shown in Figure 14.

The lumbar puncture, while not the direct responsibility of the radiologist, is an



Fig. 14. Upper exposure shows the opaque column at the lumbosacral joint space. The presence of an encroaching lesion is manifest only by slight displacement of the column to the right, a small crescent-shaped filling defect on the left, and slight elevation of the adjacent axillary pouch. The exposure at the bottom of the illustration (the same case) shows the type of lateral film that can be secured with the method above described. There is posterior displacement of the column of opaque material and a small ventral filling defect at the level of the lumbosacral joint. A herniated nucleus pulposus was found at operation on the left at the level of the fifth lumbar interspace.

important consideration. The puncture should be done with the least possible trauma, the point of the needle being in



Fig. 15. Canvas support used in examination of the dorsal and cervical portions of the spinal canal.

the mid-line, well down near the ventral margin of the subarachnoid space. Trauma from an improperly done puncture may cause a defect in the column of contrast material simulating that caused by a herniated nucleus. It is needless to say that a subdural or extradural injection of the contrast material makes the examination of no diagnostic value. A third essential consideration in accurate diagnosis is a correlation of the roentgen, orthopedic, and neurologic findings. The importance of this cannot be over-emphasized.

The examination of the proximal part of the spinal canal is greatly facilitated, by a canvas support (Fig. 15), designed by Major Frank H. Mayfield, Chief of the Section of Neurologic Surgery in our hospital. Heavy canvas straps are attached to the ends of the sling. As shown in the figure, these are made fast to an extra shoulder support that was available but they can be fixed to any other piece of apparatus insuring safe weight-bearing. After the straps

are fixed to the support, they are tied about the patient's legs in order to hold them firmly. The illustration shows a support in the shoulder region bearing some weight, but this is not essential. With this sling, even a paralyzed patient can be examined at any angle up to the perpendicular with complete safety.

When the cervical spinal canal is being examined, the chin is raised and extended. This aids in preventing the contrast material from passing from the cervical region into the fluid spaces within the skull. The

Pantopaque (ethyl iodophenylundecylate) is the contrast material used in all of our myelograms. It is routinely removed immediately after completing the radiographic examination. This usually can be accomplished with very little difficulty.

The case history, roentgen findings, and operative findings in an unusual case of herniated nucleus pulposus in the cervical area follow.

CASE 5A: A 32-year-old Negro male entered our hospital having had symptoms for ten months prior to admission, including numbness and tingling in the



Fig. 15A. Case 5A: Cervical myelogram showing block of cervical canal at level of fifth cervical vertebra. The patient was in an inverted position with the head down and was almost perpendicular. Each of the serial exposures apparently shows the block at a different level. This is due to a shift in the position of the film, the obstruction being at the level of the fifth cervical vertebra.

table is then tilted, lowering the head until the column of contrast material passes the highest point in the dorsal portion of the spine, after which it is rapidly returned toward the horizontal. The contrast material will remain in the cervical portion of the canal, where it can be examined with the patient at various angles, as would be done in the lumbar region. It is necessary to raise the patient almost to the standing position before all of the opaque material will return to the lumbar area. We are indebted to Lt. Col. Aubrey O. Hampton and Lt. Col. R. Glenn Spurling, of Walter Reed General Hospital for the above method of examination.

right hand and a gradually developing spastic right hemiparesis beginning in the right arm and spreading to the right leg. The muscles of the hand were paralyzed and the patient complained only of a dull aching sensation in the right shoulder. There was no history of trauma.

The patient was well developed and well nourished, with a spastic paresis of the right leg and a mixed spastic and flaccid paralysis of the muscles of the right hand. There was loss of pain and temperature sensation on the left side of the body, a typical Brown-Séquard syndrome being present. The spinal puncture done at this hospital showed a complete obstruction of the canal, demonstrated by the Queckenstedt test. Spinal puncture and a myelogram done elsewhere, one month prior to admission to this hospital, were said to have been normal. Myelography was done, with 6 c.c. of Pantopaque, this amount being used routinely in our

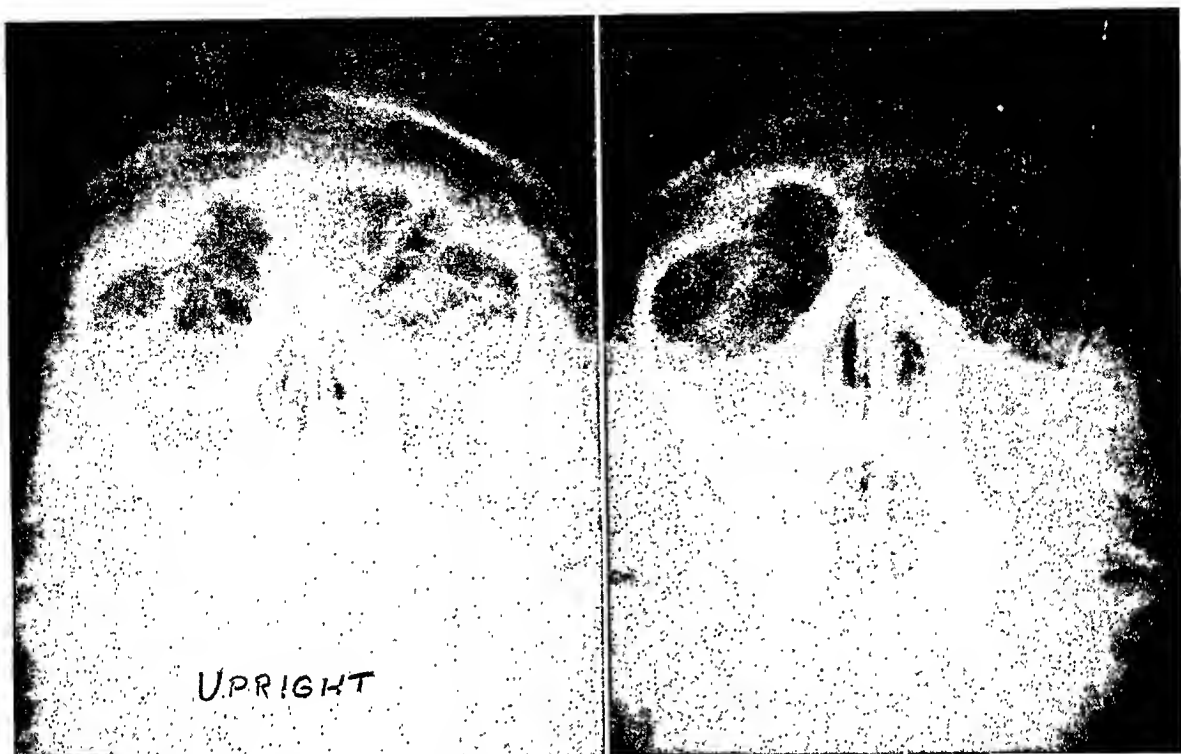


Fig. 16. Exposure of anterior sinuses in the Waters position, with the patient horizontal and upright. General clouding of the right antrum shown with the patient horizontal. Fluid level demonstrated in the upright exposure.

cervical myelograms. The progress of the column through the canal was entirely normal until it reached the level of the lower margin of the fifth cervical vertebral body. Here the column split and passed upward along each side of the canal to the level of the upper margin of the fifth cervical vertebral body, where the progress was completely arrested. At this time the patient was almost perpendicular, his head being down and his chin completely extended. There was no pulsation in the column of material and no movement upon coughing. It was obvious that there was a complete block, the lower margin of which was at the level of the lower margin of the body of the fifth cervical vertebra. It was our opinion that a tumor of some type was present, blocking the canal. Major Mayfield thought that the tumor was probably intradural but extramedullary, while we, in the x-ray department, thought that it was probably intramedullary. Our findings are shown in Figure 15A; the cephalic portion of the canal is at the lower margin of the illustration, indicating the position of the patient when the exposures were made.

At operation a large herniated nucleus pulposus was demonstrated at the level of the interspace between the bodies of the fourth and fifth cervical vertebrae. The adjacent nerve roots were not compressed thereby, accounting for the absence of pain. The cord, however, on the right side was markedly compressed. The laminae of the fifth and sixth

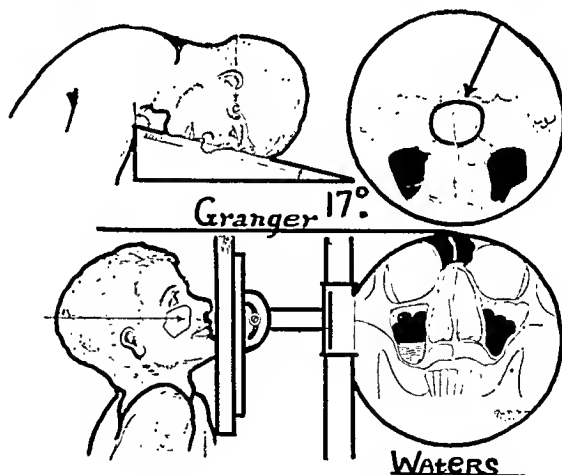


Fig. 17. Diagram by Major Heublein showing proper positioning for Granger view of sphenoids and for upright view of anterior sinuses in Waters position.

vertebrae were removed, for it had been anticipated that the lesion was a new growth and not a herniated nucleus pulposus. The herniated nucleus was removed. The patient's convalescence has been uneventful and he has shown a progressive return of function since operation.

This case seemed to us to be of unusual interest because of the slow progression of

symptoms without significant pain and with no history of trauma. We have seen one other case, demonstrated by myelography, where there was a complete block at the level of the fifth dorsal vertebra.

sinuses is done in all patients suffering from asthma and all others where such an examination appears to be indicated. Stereoscopic films are made in the Waters position with the patient horizontal, and a



Fig. 18. Routine exposures used, with the exception of the upright. Anterior sinuses on the right normal. Those on the left show evidence of extensive disease. Posterior sinuses are all clear.

The obstruction was thought to be due to a new growth but at operation was shown to be the result of a herniated nucleus pulposus.

ACCESSORY SINUSES AND FACIAL BONES

Examination of the nasal accessory

single film in the same position with the patient upright. The latter film (Fig. 16) is valuable in demonstrating fluid levels and in determining whether increase in density is due to mucosal thickening, to fluid, or to a combination of these two conditions. The Granger position (Fig. 17) is



Fig. 19. Case 6: Fracture of base of odontoid process of second cervical vertebra. A. Posterior dislocation and fracture prior to reduction. B. Position of parts after reduction. C and D. Exposures of first and second cervical vertebrae through open mouth, made shortly after injury, showing fracture through base of dens. E. Similar exposure one month after injury. Some demineralization has apparently taken place during the interval between examinations.

used for visualization of the sphenoids and posterior ethmoids, the former sinuses also being shown in the Waters position, where the exposures are made with the mouth

open. The frontal sinuses and anterior ethmoids are examined in the Caldwell position. A lateral exposure of the entire sinus area is also secured. This routine,

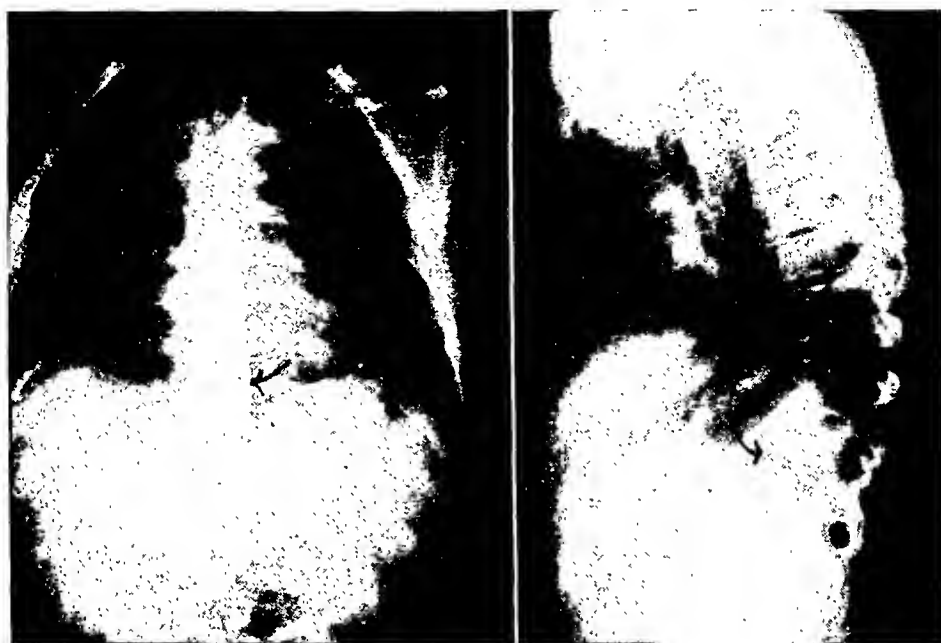


Fig. 20. Changes characteristic of an advanced Scheuermann's disease in the dorsal spine. The changes are particularly marked in the vertebral bodies indicated by arrows.

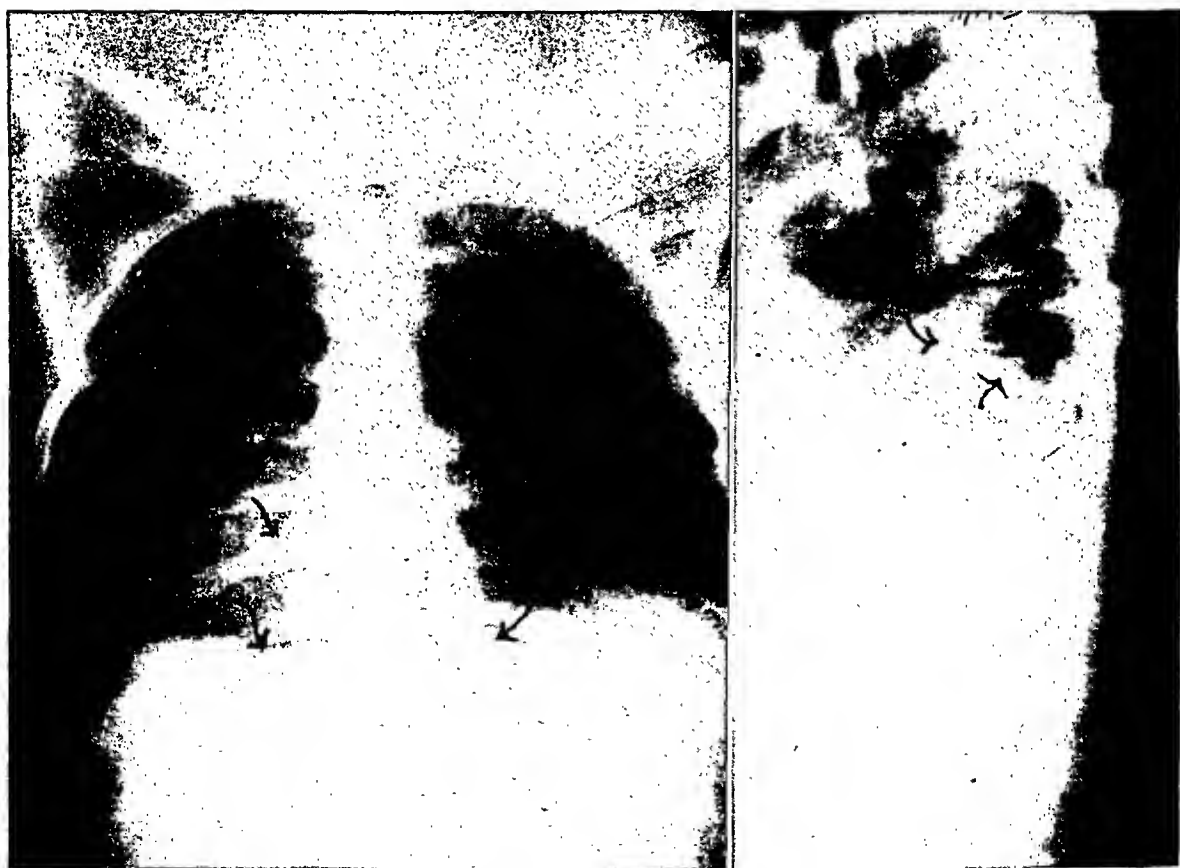


Fig. 21. Case 7: Tuberculosis of the dorsal spine, with paravertebral abscess and destruction of the vertebral bodies.

shown in Figure 18, has proved very satisfactory and with such films a high degree of accuracy in diagnosis is possible. Sinus disease in itself has not been a very important permanently disabling condition in our patients but has been quite significant from the standpoint of temporary disability.

A number of severe traumatic lesions of the bones of the face have been seen. In demonstrating these, films are made in the Waters position together with lateral stereoscopic views. Such an examination is most satisfactory in the majority of instances. Experience teaches one the type and number of fractures that are likely to be encountered. For example, when there is a fracture of the zygomatic arch or separation at the joint between the temporal process of the malar and malar process of the temporal, there usually are fractures of the superior and inferior walls of the adjacent antrum. Bilateral fractures of this type are not uncommon.

THE SPINE

We have seen a large number of severe traumatic lesions of the cervical spine, the common ones being fractures of the cervical vertebral bodies, at times with associated fractures of the adjacent posterior processes with or without dislocations, fractures of the odontoid, and in a few instances rotary dislocations of the first cervical vertebra. The latter are sometimes produced by a cervical adenitis which causes relaxation of the ligamentous structures with subsequent spontaneous rotary luxation of the atlas on the axis. It is well to bear in mind the fact that fractures of the odontoid process may become evident only after calcium absorption about the fracture has taken place and may not be demonstrable before ten days to three weeks following the initial trauma.

The following case is illustrative of a fracture of the base of the odontoid.

CASE 6: A 26-year-old private, first class, gave a history of having been thrown from a truck and landing in an unknown manner. He was unconscious for a period of twenty-four hours and had



Fig. 22. Spondylolisthesis, second degree. Exposure of lumbosacral area using small diaphragm. Defects in posterior processes well shown.

difficulty in swallowing after he regained consciousness. Physical examination showed hyperactive reflexes in the left arm and limitation in motion of the cervical spine. X-ray examination showed a fracture through the base of the dens with posterior displacement. Head traction for a period of six days resulted in satisfactory reduction, and a plaster cast including the upper part of the thorax, the neck, and the greater part of the head was applied. Disability for a period of from four to six months is anticipated. Figure 19 shows the fracture in the lateral projection before and after reduction, as well as anteroposterior views of the fracture through the open mouth.

In the dorsal region bone and joint changes resulting from a juvenile epiphyseitis, known as Scheuermann's disease, shown in Figure 20, have been found not infrequently in patients complaining of back pain. Many of the vertebral bodies have been quite noticeably deformed, and secondary hypertrophic changes have often been present. From the standpoint of dis-



Fig. 23. Case 8: Diffuse calcification in the kidneys and cystic changes in femur and ilium in a patient with a parathyroid adenoma. There were cystic changes in other bones, including minute areas of calcium absorption throughout the skull.

ability in soldiers, the significance of this condition has not been determined with certainty.

A typical case of tuberculosis of the dorsal spine with a paravertebral abscess is shown in Figure 21. The case history is as follows:

CASE 7: A 23-year-old private, first class, was admitted to Percy Jones General Hospital on Sept. 25, 1943, giving a history of pain in the dorsal area which he noticed two weeks after induction. When ordered to do double time in drill, he fell to the ground, was hospitalized, but after a brief period returned to his duties. He began to lose weight and continued to complain of pain in the lower dorsal region. He was again hospitalized, at which time he was found to have an afternoon fever. He was transferred to this hospital with a diagnosis of chronic perinephritis. Examination of the urine revealed nothing abnormal. Our x-ray examination showed destruction of portions of the bodies of the ninth, tenth, eleventh, and twelfth dorsal vertebrae with the typical paravertebral abscess shown in the illustration. A spinal fusion was done Nov. 17,

1943. The postoperative course was uneventful, and the patient was discharged to the Veterans' Facility for further care.

In the lumbar region, the most common disabling condition found has been herniation of the nucleus pulposus, usually at the level of the fourth or fifth lumbar interspace. All patients suspected of having this condition have had myelograms done.

Another lesion of the lower spinal area that has proved to be of decided importance in the Army has been spondylolisthesis. It is the opinion of our orthopedic staff that spondylolisthesis, even of the first degree, may cause relatively severe disabling symptoms. The developmental defects in the pars interarticularis have been best shown in the lateral projection using a small cone, one covering an 8 X 10-in. film at a 30-inch focal distance. A typical example is shown in Figure 22.

BONES AND JOINTS

Some tumors of the bone have been found. There have been four endothelial myelomas, one osteogenic sarcoma, a few metastatic lesions of bones secondary to malignant tumors elsewhere, and one case of cystic disease of the bone secondary to a parathyroid tumor. Illustrative cases follow.

CASE 8: A 23-year-old technician, fifth grade, gave a history of having passed a small urinary calculus in the summer of 1939 and recovered satisfactorily. He was well until August 1943, when he experienced indefinite pain in the lower back and a sense of soreness in the region of the left ilium. In September he was somewhat nervous and on Sept. 14 was first hospitalized because of pain in the left hip. Some relief resulted from sedatives and local application of heat. X-ray examination showed diffuse calcification throughout the kidney areas and cyst-like areas of decreased density in the right ilium, the proximal third of the right femur, and in the neck and the distal third of the left femur. These changes were considered characteristic of hyperparathyroidism.

Examination at this hospital revealed the changes noted on examination prior to admission. Intravenous studies of the urinary tract showed essentially normal function and collecting system. The calcium deposits were in the kidney parenchyma.

Examinations on Oct. 29 showed the red cell count to be 4,100,000, white cell count 8,500, hemoglobin 78 per cent, blood phosphorus 3.4 mg. per cent, blood phosphatase 22 units, and serum calcium 18.7 mg. per cent.

Operation, Nov. 8, 1943, revealed a large, firm, grayish mass lying behind the left lobe of the thyroid. Frozen section showed this to be a tumor of the left parathyroid gland. The tumor was removed. The right parathyroid was examined and was thought to be slightly hypertrophied but was not removed. The postoperative course was uneventful except for generalized joint pains associated with moderate elevation of the temperature, swelling, redness, and pain on movement of various joints. The serum phosphate fell promptly. The fall of the serum calcium was slow, but both were normal by the third postoperative day. There was a gradual rise in the serum phosphate after the twelfth postoperative day, the highest point being reached approximately six weeks after operation, when the serum phosphate was 4.5 mg. per cent and the serum calcium 12.5 mg. per cent. The serum calcium had been 15.3 mg. per cent the previous day. These were the highest readings obtained at any time. The last blood examination was done March 7, 1944, when the serum phosphate was 3.0

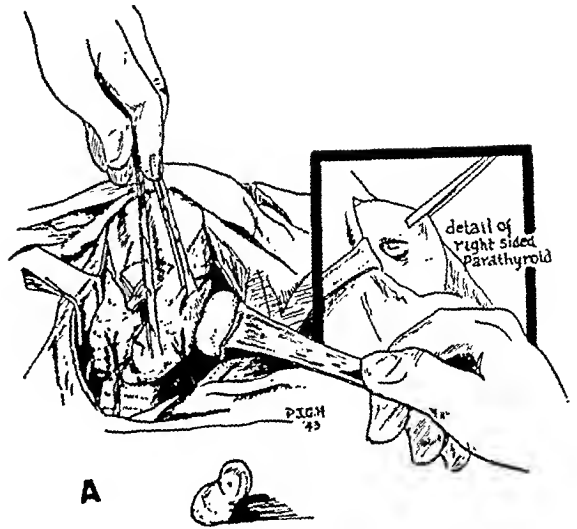


Fig. 24. Case 8: A. Drawing made at operation showing tumor of left parathyroid lying posterior to the left lobe of the thyroid, which was retracted. Right side shown for comparison. B. Photomicrograph of parathyroid adenoma, chief-cell type. Section reveals typical adenoma of parathyroid, showing densely massed cells with formation of occasional alveoli containing colloid-like secretion.

mg. per cent and the serum calcium 12.4 mg. per cent.

The patient is having no symptoms at the present time, but repeated x-ray examinations have shown no appreciable change in the lesions of the bones or kidneys. Our findings in this case, including a drawing of the tumor, are shown in Figures 23 and 24.

Another unusual bone lesion is shown in Figure 25.

CASE 9: A 19-year-old Negro private was admitted to Percy Jones General Hospital Sept. 3,

1943, with a history of pain in both thighs and the lower abdomen since July 21, 1943. He was admitted to the Station Hospital, Fort Custer, from the Reception Center because of inability to walk. He had a temperature, at the time, of 103° and evidence of a polyarthrititis. A presumptive diagnosis of rheumatic fever was made. X-ray examination at the Station Hospital showed a peculiar periosteal reaction along the margin of the femur and one humerus. A biopsy was done and a small amount of pus was found beneath the periosteum. Microscopic examination of the tissue removed showed only inflammatory changes. Following surgery the pain in the thigh disappeared and the patient was

Metastatic bone lesions showing a satisfactory response to radiation are illustrated in Figures 26-28.

CASE 10: A 54-year-old officer gave a history of dull pain in the back that radiated around the lower ribs on the left side, beginning in September 1942. An examination of the gastro-intestinal tract, including the colon, was negative at that time. We found complete destruction of the left pedicle of the tenth dorsal vertebra. A chest film, shown in Figure 26, revealed a small nodular lesion in the left upper lobe that in some ways resembled a tuberculous infection, but the subsequent course seemed



Fig. 25. Case 9: Irregular calcium deposits beneath the periosteum of the humerus and femur.

transferred to our hospital. Laboratory studies showed 3,500,000 red blood cells with a hemoglobin of 58 per cent. The sedimentation rate was 32 mm. during the first hour. The red cells showed marked sickling and many target cells were found. The patient improved rapidly while in this hospital and was discharged to a Veterans' Facility for further observation.

The above abnormalities, in our experience, are unusual, apparently being the result of a low-grade inflammatory process. The patient had an obvious sickle-cell anemia, but there seemed to be no connection between the anemia and the peculiar bone changes.

to indicate that it was due to a bronchiogenic carcinoma. The patient also complained of pain in the right foot, and films showed a destructive lesion in the cuboid. A biopsy of the area of destruction in the cuboid was done after considerable roentgen therapy, and a metastatic adenocarcinoma of unknown origin was identified. Roentgen therapy was started Feb. 1. The back pain promptly subsided, as did the pain in the foot. Subsequent examinations of the chest showed considerable regression of the lesion in the left upper lobe, the latest films showing only a small area of fibrosis (Fig. 26, D) in the area where quite a discrete mass had previously been demonstrated.

The patient was discharged to duty March 30, 1943. In June 1943, he was still asymptomatic. A

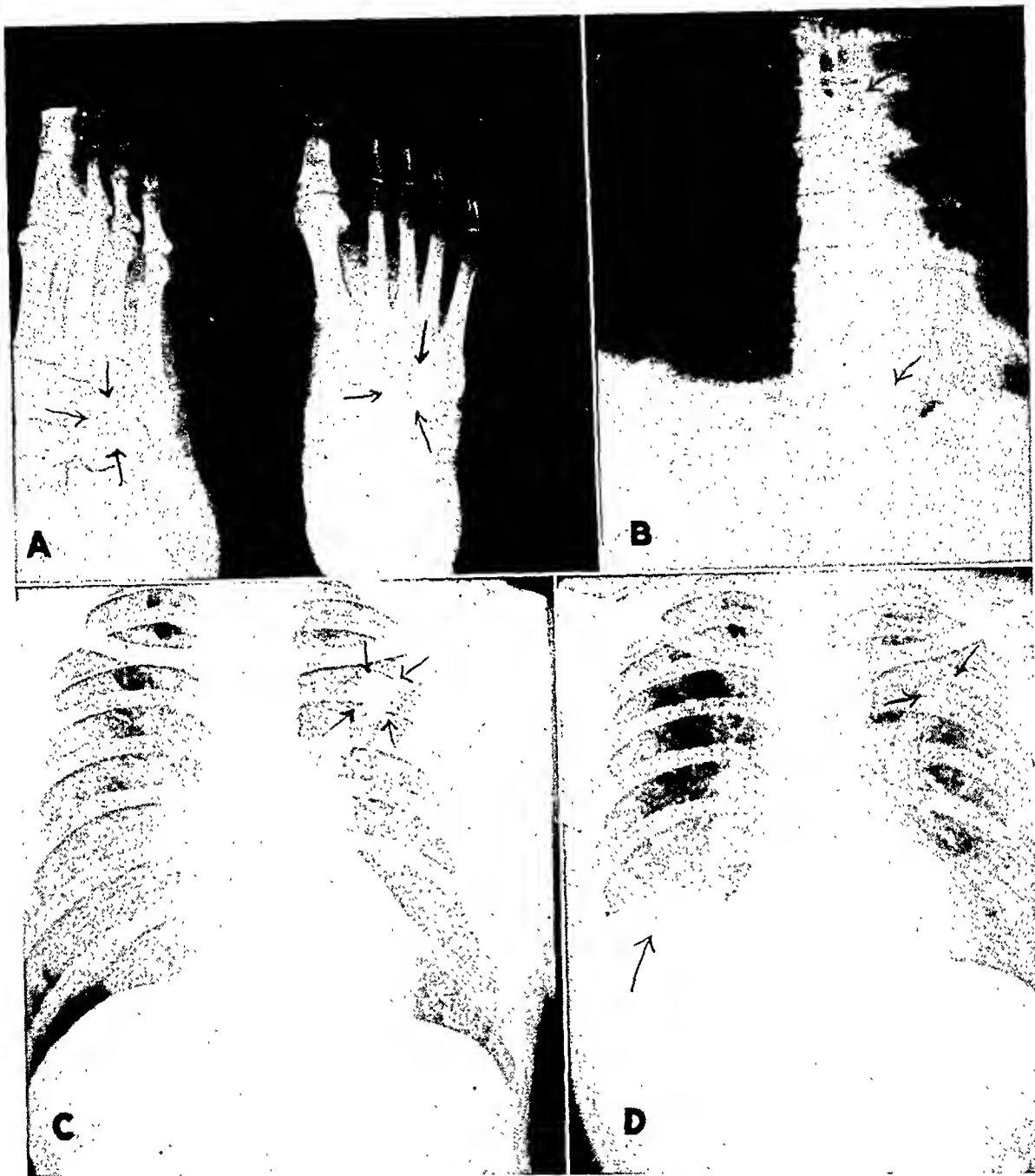


Fig. 26. Case 10: Metastatic carcinoma. A. Area of destruction in cuboid. B. Destruction of pedicle of fifth dorsal vertebra and recalcification of pedicle of tenth dorsal vertebra following irradiation over the latter area. C. Rather sharply circumscribed shadow in left infraclavicular area, apparently due to a bronchiogenic carcinoma. D. Chest eleven months later, following deep radiation therapy over the area of circumscribed shadow in the left infraclavicular region. Only a few linear areas of fibrosis remain. At the time this film was made the patient had an atelectasis of the right lower lobe. He had a cold and refrained from coughing because of sacral pain. Postural drainage resulted in prompt relief of the apparent bronchial obstruction and the lobe became normal.

survey of his bones showed complete healing with recalcification in the tenth dorsal vertebra. However, the left pedicles of the fifth and seventh dorsal vertebrae showed evidence of destruction similar

to that previously noted lower down. Roentgen therapy was given over the involved pedicles, and subsequently examination showed healing with recalcification (Fig. 27).

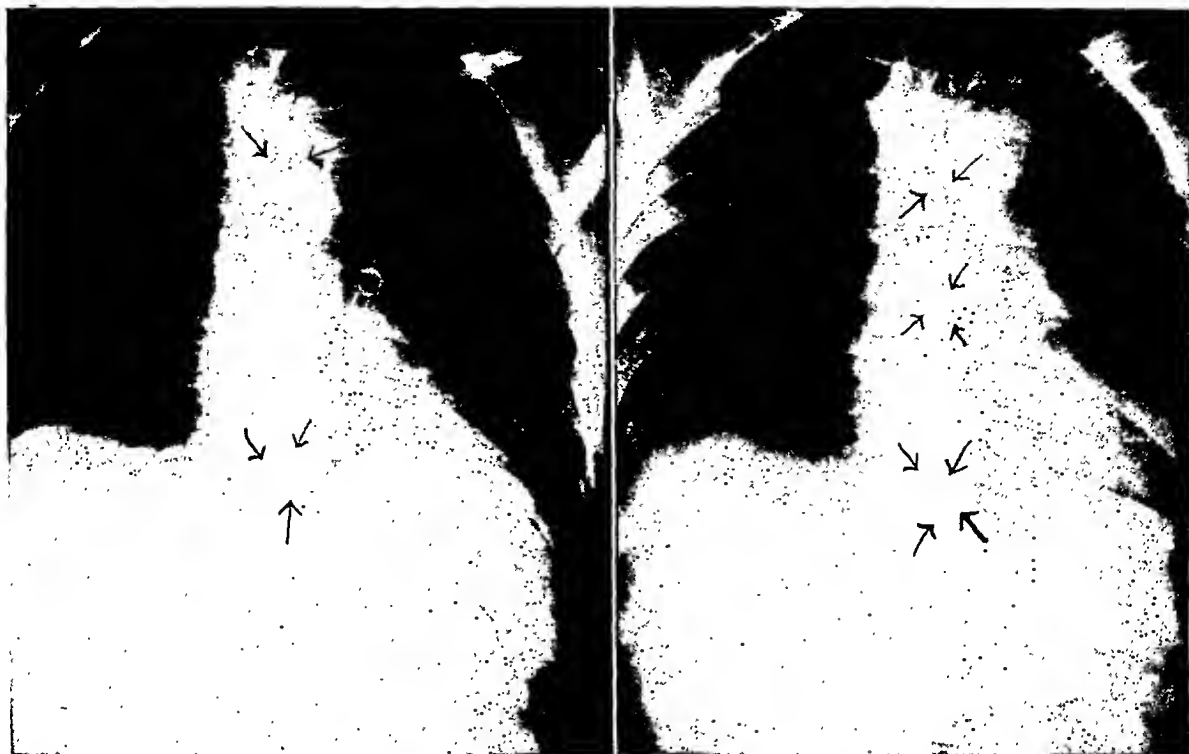


Fig. 27. Case 10: Metastatic carcinoma. Films of the dorsal spine showing recalcification following radiation over involved pedicles.

The patient was readmitted Nov. 22, 1943, because of severe pain in the region of the sacrum. A large destructive lesion of the sacrum was found (Fig. 28). Again deep radiation was resorted to with prompt disappearance of pain. The patient improved rapidly and once more went back to duty. He returned in March 1944, complaining of retro-orbital pain. A survey of the entire skeletal system was done. The lesions in the spine and sacrum had healed, with recalcification, but three areas of destruction were found in the skull. They were similar to the ones earlier observed in the spine and sacrum. The retro-orbital pain disappeared promptly following the beginning of irradiation of the skull.

The arthritides, from a radiographic standpoint, have not been a major problem in our institution. Many cases of poly-arthritis have been examined, but except for showing early demineralization, indistinguishable from that seen in disuse, and occasional cystic lesions of the short bones mimicking gout, the radiographic findings in rheumatoid arthritis have been largely negative. This is due to the fact that most cases so far examined have been early.

Spondylitis rhizomélique, also known as atrophic spondylitis or the Marie-Strümpell type of arthritis, has played a much more important role. The histories are quite similar, the most characteristic feature being exposure to abnormal climatic conditions, either in basic training or on bivouac overseas. The following is a typical story.

CASE 11: A 33-year-old soldier dated the onset of his illness from a drenching he received while in bivouac on Guadalcanal in November 1942, when his tent was blown away by a tropical storm. Stiffness in the back and shoulders, neck, and elbows developed and progressed, becoming increasingly painful. His lumbago became so severe that it prevented him from doing duty. On admission to this hospital he complained of stiffness in the entire back and bilateral leg pain. Physical examination showed limitation of motion of the spine in all directions. The sedimentation rate was 74 mm. during the first hour. Roentgenograms revealed atrophic disease involving the entire spine, with the most advanced changes in the sacroiliac joints. The patient had great difficulty in getting on the therapy table. After his first series of treatments with intermediate therapy, prompt improvement took place and he was able to participate in limited physical

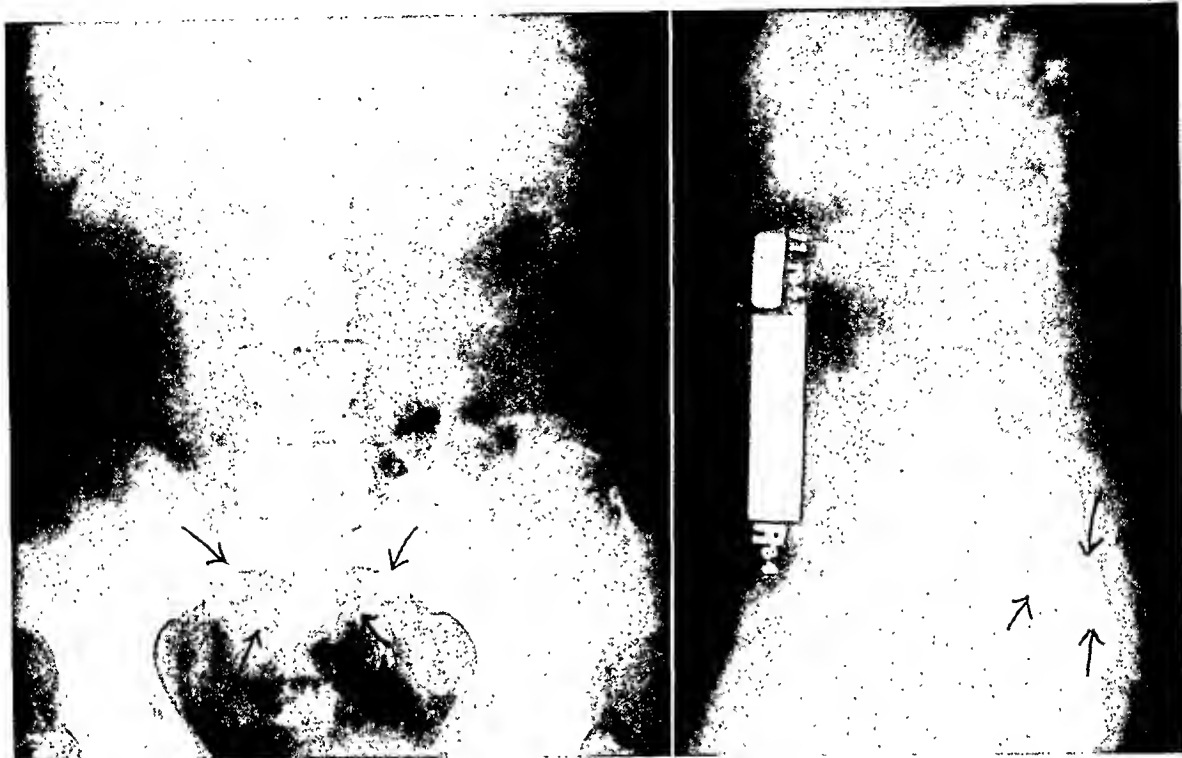


Fig. 28. Case 10: Metastatic carcinoma. Extensive destruction of the proximal half of the sacrum resulting from a metastatic tumor. Prompt relief of symptoms and recalcification followed irradiation over this area.

activities, such as table tennis. His response to irradiation remained satisfactory over a period of several months while he was under observation here.

Approximately 75 per cent of such cases have shown significant improvement following roentgen therapy. Little if any improvement has resulted in those cases with no clear-cut roentgenographic evidence of disease or in those showing no elevation of the sedimentation rate.

Traumatic arthritis of the knees has been a frequent disabling condition, and the radiographic findings have been striking. Besides conventional films of the knee, it is important to include a flexed-knee projection of the intercondyloid fossa in almost every instance. This projection frequently shows the calcification of Pellegrini's disease to better advantage than other views. It is indispensable in demonstrating loose bodies, the defects of osteochondritis dissecans, and other defects in the surfaces of the condyles.

The clinical stories of the patients examined have had much in common. There

has been either a fall from a height, direct trauma by a heavy falling object, or, more commonly, a twisting injury often received when playing high school or college football. Following the initial injury there frequently is a history of "locking," or of the knee "giving out." After induction into the Army there usually have been episodes of pain due to recurring hydrarthrosis or on pivoting in close-order drill or in field maneuvers. Physical examination often has indicated the presence of joint mice, crepitus, a thickened capsule, relaxed capsular ligaments, or instability due to a damaged anterior cruciate ligament. The radiographic examinations at times have shown one or more loose osteochondromatous foreign bodies in the joint capsule and defects in the articular surfaces of the condyles.

Pellegrini-Steida's disease and osteochondritis dissecans have been encountered quite frequently in examinations of the knees. Both can cause protracted symptoms and severe disability in men on active

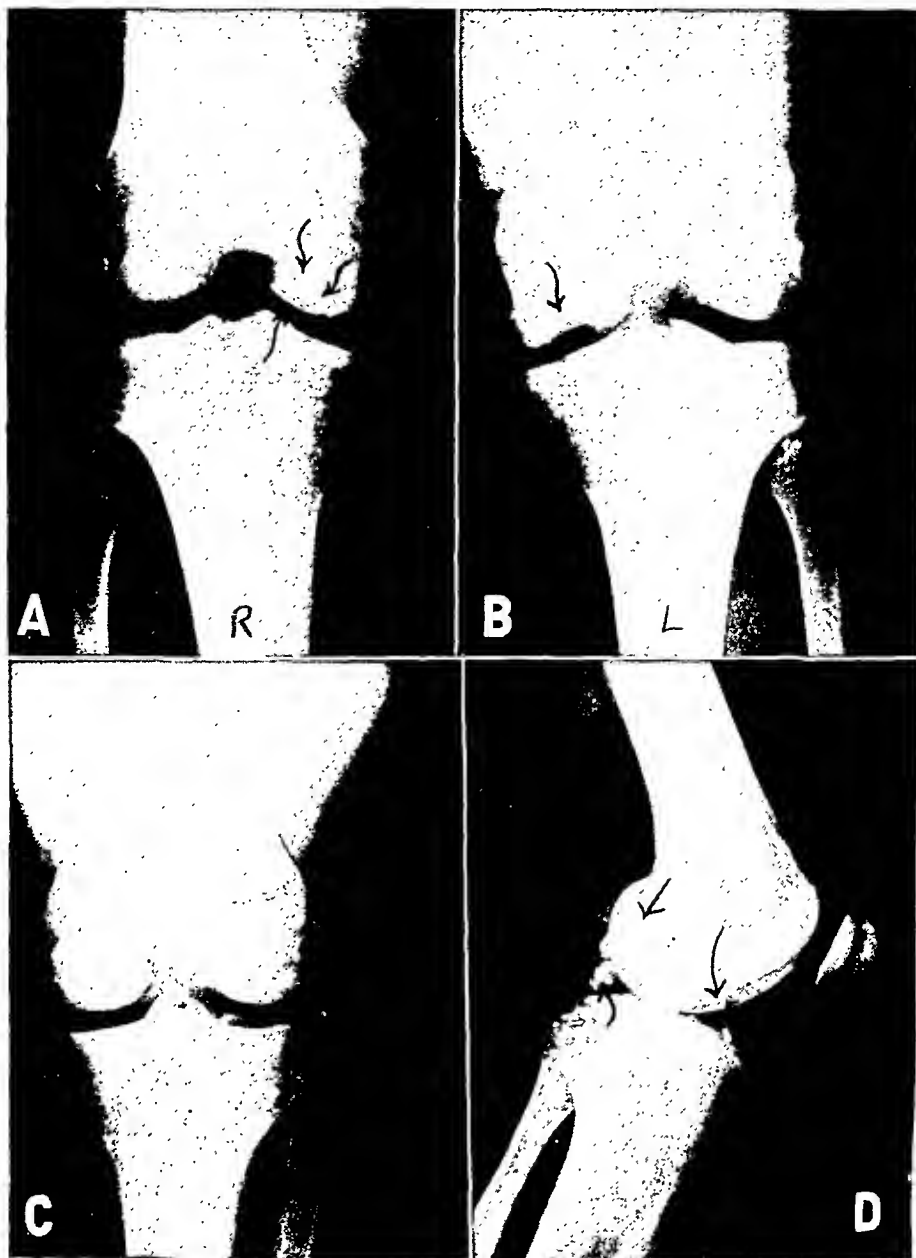


Fig. 29. A and B. Case 12: Bilateral osteochondritis dissecans. A. Partially separated loose fragment indicated by arrows. B. Large defect in articular surface of left femur. C and D. Another case, showing multiple calcified bodies within the knee joint.

duty in the field. It must be borne in mind that either of these may be bilateral, and for this reason the uninvolved joint should be examined carefully.

A typical case of osteochondritis dissecans is shown in Figure 29, A and B.

CASE 12: A 20-year-old private gave a history of injuring both knees in high school and college. He frequently suffered from pain in his knees and at times from "locking." Pain continued after induc-

tion and the x-ray films made at this hospital upon admission showed bilateral osteochondritis dissecans. On March 16, 1943, arthrotomy was done on the left. Two large calcified bodies were removed and a large defect in the condyle was curetted. The postoperative course has not been very satisfactory. Pain has continued and there is considerable limitation in the movement of the knee.

Multiple calcified bodies in the knee joint as seen roentgenographically are shown in Figure 29, C and D.

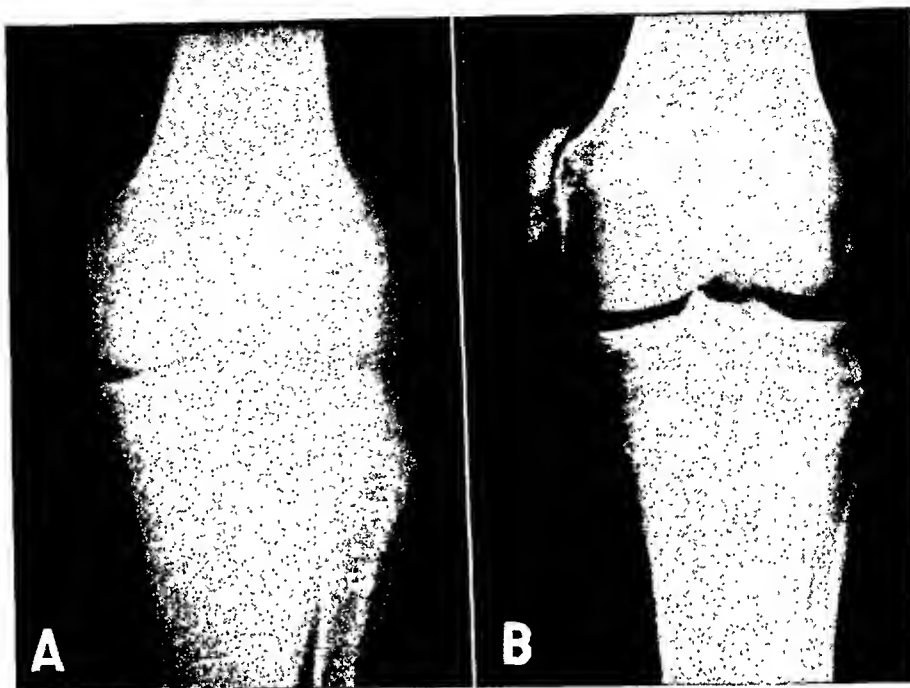


Fig. 30. Case 13: Pellegrini-Stieda disease. A. Region of knee shortly after injury, showing no abnormalities. B. Film made several months after injury, showing evidence of Pellegrini-Stieda disease. Calcification medial to the condyle is extensive.

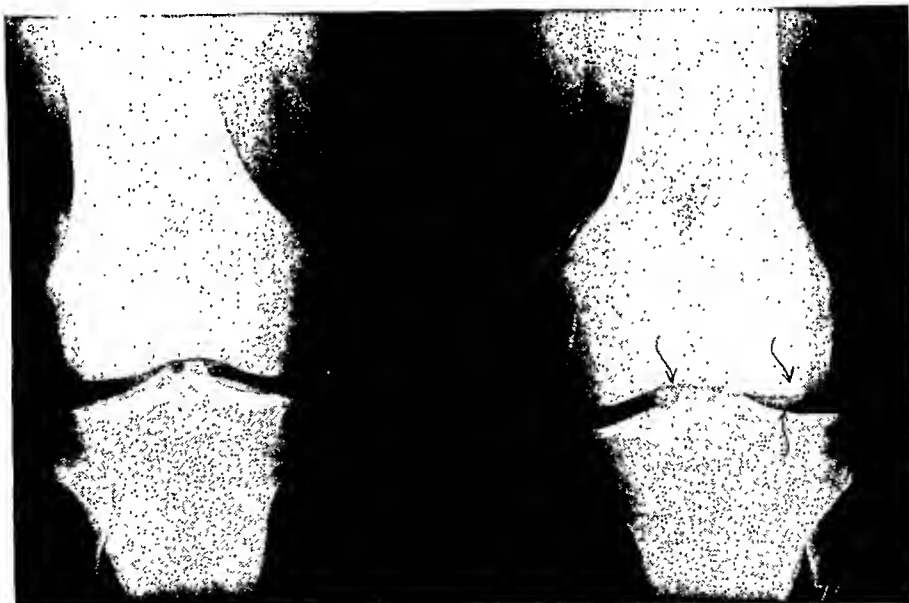


Fig. 31. Bilateral Pellegrini-Stieda disease together with multiple calcified bodies within the joint space of the knee, shown on the right.

A typical case of Pellegrini-Stieda's disease is illustrated in Figure 30.

CASE 13: A 26-year-old private, first class, gave a history of having injured his left knee in an attempt to avoid a tree while tobogganing. A cast was applied but was removed after one month, when

physiotherapy was begun. The knee remained stiff and it was then manipulated under anesthesia. The patient was placed on limited duty at light work, but continued to have symptoms. Physical examination showed atrophy of the thigh and a firm, apparently bony prominence over the internal condyle of the femur. Our examination showed a

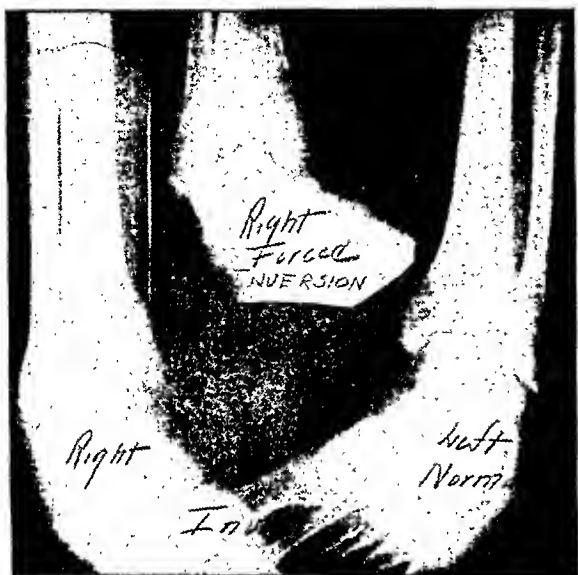


Fig. 32. Recurrent dislocation of the right ankle. The right ankle is shown both in inversion and forced inversion, with the normal left ankle shown for comparison.

large irregular deposit of calcium in the periarticular soft tissues medial to the medial condyle. On Feb. 22, 1944, a calcium plaque was removed at operation. The reason for the operation was that the calcium plaque spanned the joint. Ordinarily these lesions are not treated surgically. There was still considerable limitation in the motion of the joint at the time of this report.

One type of joint disability which deserves special mention is recurrent dislocation of the ankle. According to Watson Jones, there is usually a history of chronic strain or instability on walking over rough ground. Sudden inversion of the ankle may cause the patient to fall. A lesion is to be suspected in anyone who complains of turning his ankle frequently following a severe sprain. Conventional roentgenograms may show no abnormality; as a result, the examining officer may conclude that no traumatic changes are present. Films of both ankles made in the anteroposterior position in forced inversion make the diagnosis clear, showing that there has been a tear of the anterior talofibular ligament, permitting a partial dislocation of the astragalus upon forced inversion. Early diagnosis is important and adequate anesthesia may be needed before satisfactory films can be secured. An example of this is shown in Figure 32.

Lateral views are not particularly informative, although an old sprain fracture of either malleolus may lead one to suspect the presence of such an injury. This injury is particularly important in view of the fact that novocain injections are frequently used in the treatment of sprains. Too early use of the damaged part is likely to increase the disability and result in an unstable ankle with recurring subluxations.

This hospital being an amputation center, many stumps are seen. The staff of our orthopedic service is chiefly concerned with the presence of sequestra or spurs in the weight-bearing area. Large spurs do not necessarily indicate an unsatisfactory stump, providing they are not in a weight-bearing area. It behooves the radiologist to be familiar with the various types of good functional stumps in order that he may give the maximum aid to the referring physician. The presence of metallic foreign bodies, fractures, evidences of infection in the soft tissues, and demineralization are reported. In certain instances of painful stump we have found it advantageous to do our examination with the prosthesis in place, with and without weight-bearing.

THE CHEST

Because of the nature of the work in a hospital of this type, relatively few acute chest infections are seen. We see many more of the sequelae of these infections, such as empyema, a surprisingly large number of cases of bronchiectasis, and an occasional lung abscess. Many of the cases of bronchiectasis apparently are of a relatively acute nature following the so-called atypical pneumonias. A few have been of long standing.

Many patients suffering from empyema have been and are being treated in our hospital. Approximately one-third of these cases have followed atypical pneumonia. It has been thought that empyema as a sequel of atypical pneumonia did not exist or was exceedingly rare, but such has not been our experience. Less than one-third of the cases have been of a miscellaneous

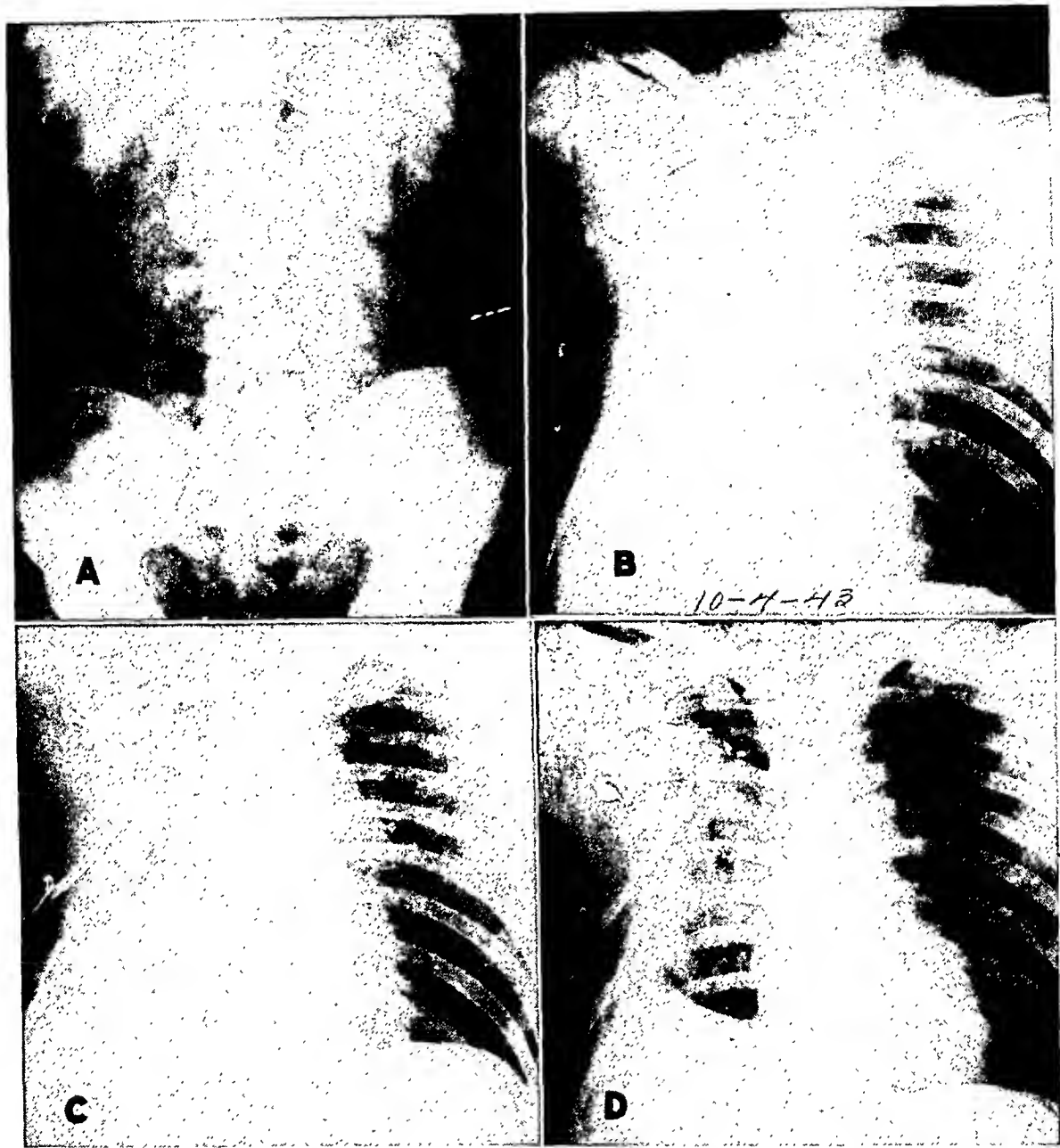


Fig. 33. Case 14: Postoperative atelectasis. A. Stone in left kidney pelvis. B. Film made a few hours after operation, showing postoperative atelectasis. Fragments of shrapnel can be seen, together with changes resulting from the previous empyema and thoracoplasty. The mediastinal structures are shifted to the right. C. Partial clearing of right lung following bronchoscopic drainage. D. Condition of chest forty-eight hours later. The mediastinal structures have returned to their normal position. The right lung is clear aside from the changes resulting from the previous empyema, the thoracoplasty, and the gunshot wound.

nature; a few followed pneumococcus pneumonia, a very few were tuberculous in origin, and in one instance the colon bacillus was the organism found. One-third have followed gunshot wounds of the chest, a hemothorax having first developed, which was followed by secondary infection.

Most of the infections have been of long standing when first seen. The purulent material has often been encapsulated, with a thickened pleura surrounding it. Bronchopleural fistula has been a frequent complication.

The results of treatment with open or

closed drainage, suction, and thoracoplasty as indicated, together with breathing exercises, a high-vitamin diet, and careful nursing care, have been most gratifying. A high percentage of these patients have been returned to active duty.

Atelectasis, usually postoperative, is seen occasionally. A case of unusual interest is shown in Figure 33.

CASE 14: A 31-year-old private was wounded by an explosive bullet while on duty in the South Pacific, Nov. 24, 1942. A hemothorax developed, and bleeding was profuse. He was carried on a litter for three days, lying in a swamp at night. Sulfanilamide was applied locally. He was treated at a battalion aid station, evacuated to a hospital one mile farther back, and then flown by plane to another installation, where a chest examination showed fluid on the right. The fluid was aspirated, being largely blood. The wound was said to have been of the sucking type. The chest wound was closed and the patient was transferred to a hospital in Australia. Purulent material was aspirated from the right pleural space at this time. A rib resection was done, a drainage tube was inserted, and the empyema space irrigated with Dakin's solution. The patient arrived at Letterman General Hospital in February 1943, where further operative drainage was done. On March 11, 1943, a diagnosis of malaria was made, the parasite being *Plasmodium vivax*. Atabrine was given, and the patient was transferred to Percy Jones General Hospital.

A draining wound was present in the right side of the chest. A bronchopleural fistula was demonstrated March 25, 1943, by injecting lipiodol through an intratracheal catheter. The patient improved under medical management. The thoracotomy wound was still open June 10, 1943, and a large residual empyema cavity remained. More adequate drainage was done June 15. Following this operation the patient improved. A thoracoplasty was done Aug. 2, 1943. The bronchopleural fistula persisted and a second operation was done on Aug. 31, at which time the fistula closed.

The patient was transferred to the department of urology Sept. 11, 1943, because of a stone in the left kidney pelvis (Fig. 33, A). The stone was removed and a postoperative atelectasis developed on the right (Fig. 33, B). The atelectasis cleared promptly following aspiration (Fig. 33, C and D). The post-operative course was otherwise uneventful except for pyuria, which gradually subsided.

The patient was returned to the chest service Dec. 1, 1943, because of continued drainage from the chest. The fistula closed gradually and by Jan. 23, 1944, the drainage was slight. On Feb. 1, 1944, the general condition was excellent, the bronchopleural fistula had closed, and only a small superficial sinus tract remained.

Bronchography with lipiodol as a contrast medium is an important examination and no effort is spared to delineate all portions of the bronchial tree. The importance of complete filling of all branches is shown by the number of patients in whom there has been bronchiectasis in one of the lower lobes, but with involvement of other lobes as well. This is particularly true of the lingular branch of the bronchus of the left upper lobe. If bronchography is resorted to, a complete examination of all branches is essential.

All lipiodol instillations are done in the X-Ray Department by a member of the chest group. The injection is made through a flexible catheter passed into the upper part of the trachea. The filling of the bronchial tree is done under fluoroscopic guidance, making certain that all branches are satisfactorily outlined, the patient being placed in various positions to insure complete filling of all lobes. Figure 34 shows the bronchial tree as outlined by this method.

The bronchogram in a typical case of bronchiectasis is shown in Figure 35. The following is the history:

CASE 15: A 36-year-old sergeant gave a history of frequent chest colds since having measles in 1922 complicated by pneumonia. He was in bed for six months in 1927 because of a productive cough with night sweats. A similar episode occurred in 1937. Large amounts of purulent sputum had been raised for a period of five to six years before induction. The sputum was occasionally tinged with blood. Physical examination showed clubbing of the fingers. The breath sounds at the left base were impaired. The bronchogram revealed an extensive bronchiectasis of the left lower lobe with minimal bronchiectasis on the right. Sinus examination showed extensive mucous membrane thickening in the antra. The vital capacity was 3.7 liters, a 16 per cent deficiency. The hospital course was uneventful. The patient was discharged without operation.

Our interest in coccidioidomycosis has recently been stimulated by the arrival of an occasional patient with this disease from the southwestern states, where it exists in endemic form. Much credit is due to the men on our chest service for the prompt diagnosis of this condition. The chief roentgen findings have been notable, in

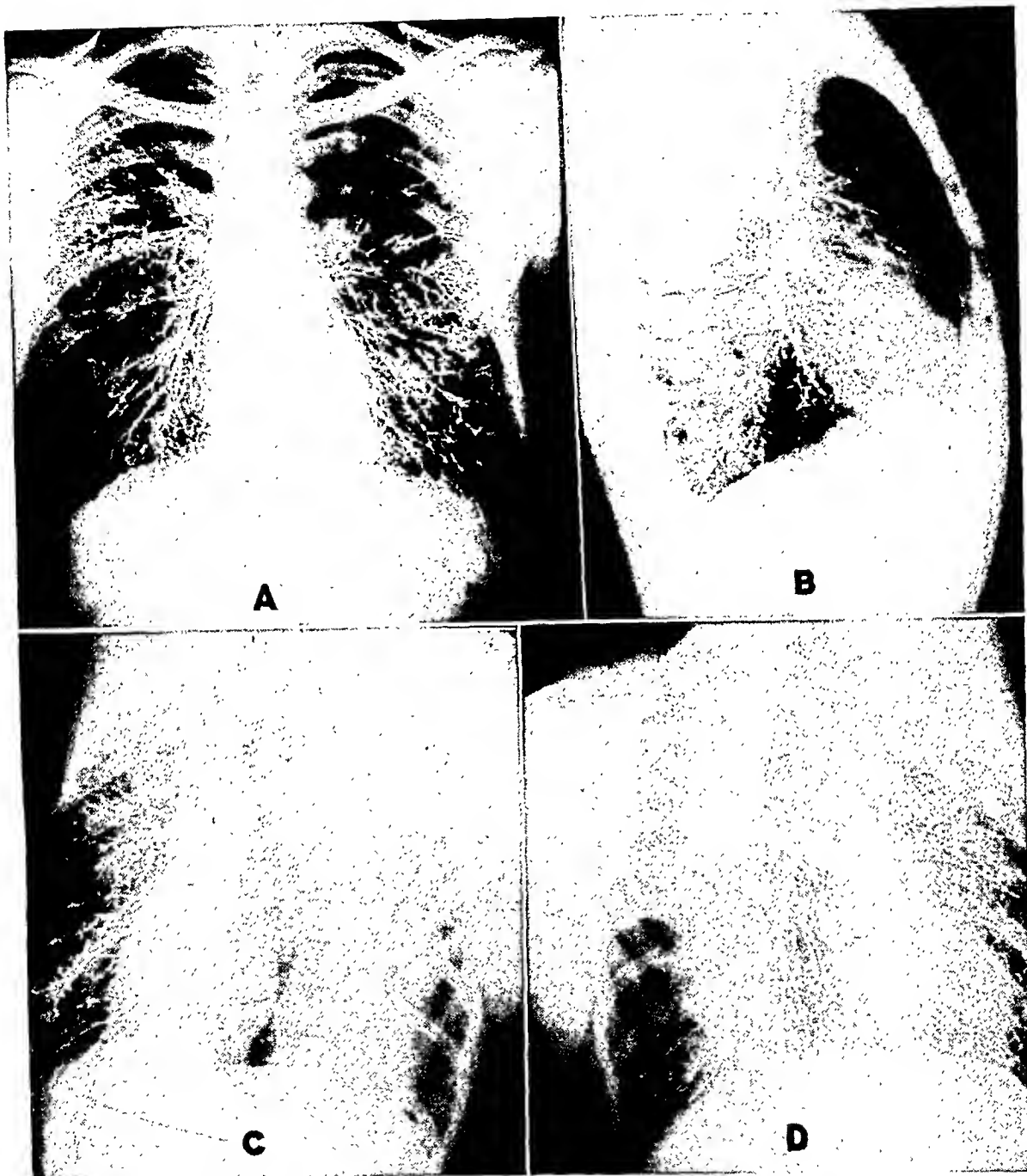


Fig. 34. Bronchography. A. Normal bronchogram, made in postero-anterior position, showing complete filling of all branches. B. Lateral projection made after filling the branches of the right bronchus, but before filling the branches on the left. A lateral view with both sides filled is of little value. C. Left postero-anterior oblique projection, showing structures on right before filling left side. D. Right postero-anterior oblique projection, both sides being filled. This shows particularly well all branches of the left bronchus.

These four films are the ones routinely used in bronchography. We usually obtain a postero-anterior view of the side first filled as well.

that they may be indistinguishable in appearance from those caused by tuberculous or non-tuberculous pulmonary infections. We have found it necessary to

bear this diagnosis constantly in mind when dealing with any bizarre type of pulmonary lesion, whether it be apical or basal in distribution, and to inquire regarding the skin

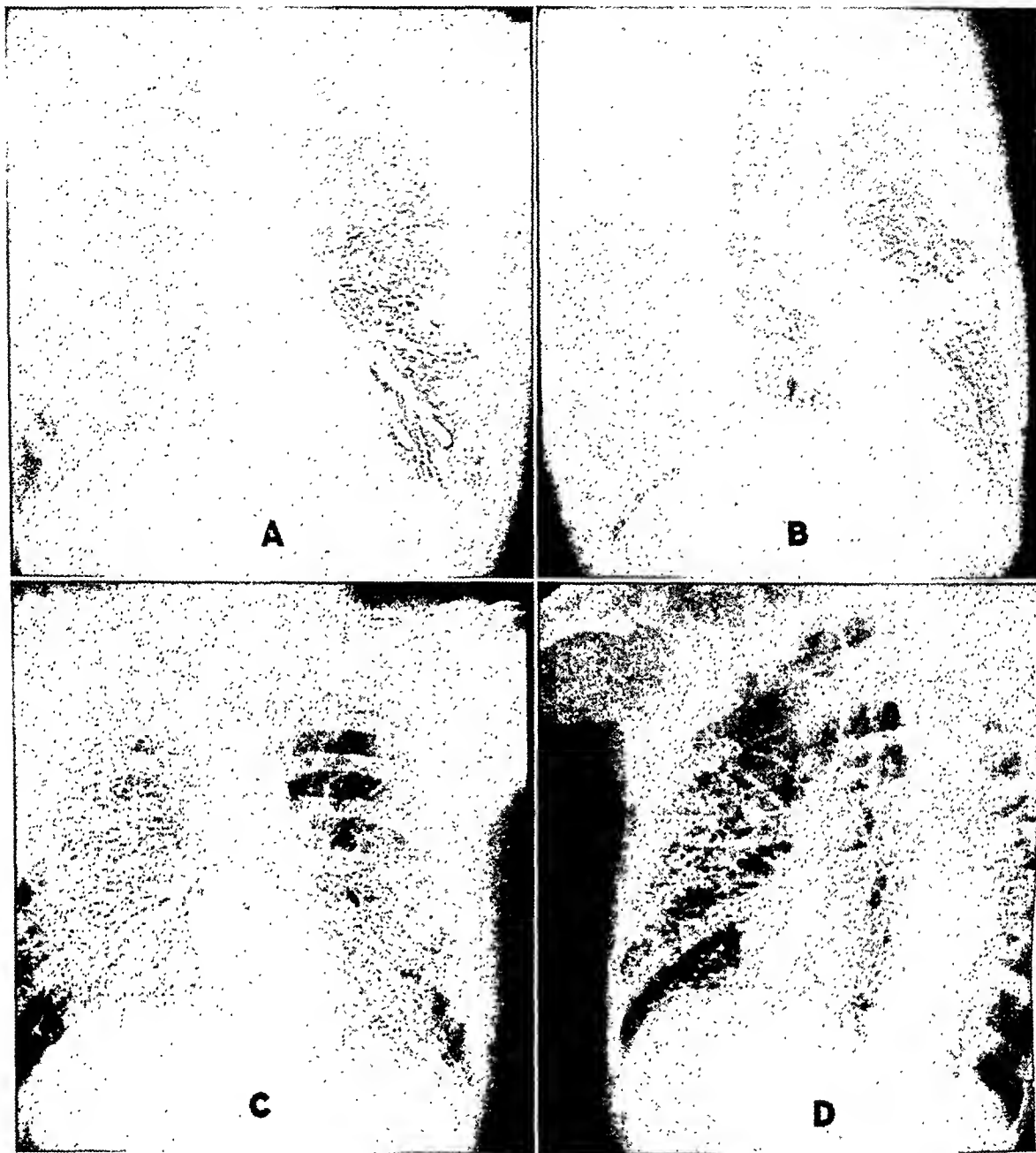


Fig. 35. Case 15: Bronchiectasis demonstrated by bronchography. A and B. Bronchograms in postero-anterior and right postero-anterior oblique projections, showing complete filling of all branches of the left bronchus. Extensive bronchiectasis of the left lower lobe is demonstrated. C and D. Complete visualization of all branches of the bronchus on the right shown in postero-anterior and left postero-anterior oblique projections. Minimal dilatation of some of the smaller branches of the bronchus of the right lower lobe is shown.

test, which in most instances becomes positive some time during the third week of the disease.

Semi-arid weather conditions in parts of California, New Mexico, Arizona, and Texas favor the growth of the pathogenic fungus which has been responsible for outbreaks in several Army camps. In areas

where the disease is endemic, it has now become routine to do a coccidioidin skin test on all new recruits. A positive intracutaneous test along with certain clinical signs, including the not infrequent finding of erythema nodosum and a mild arthritis, establishes the diagnosis, and in certain instances the pathogenic organism,

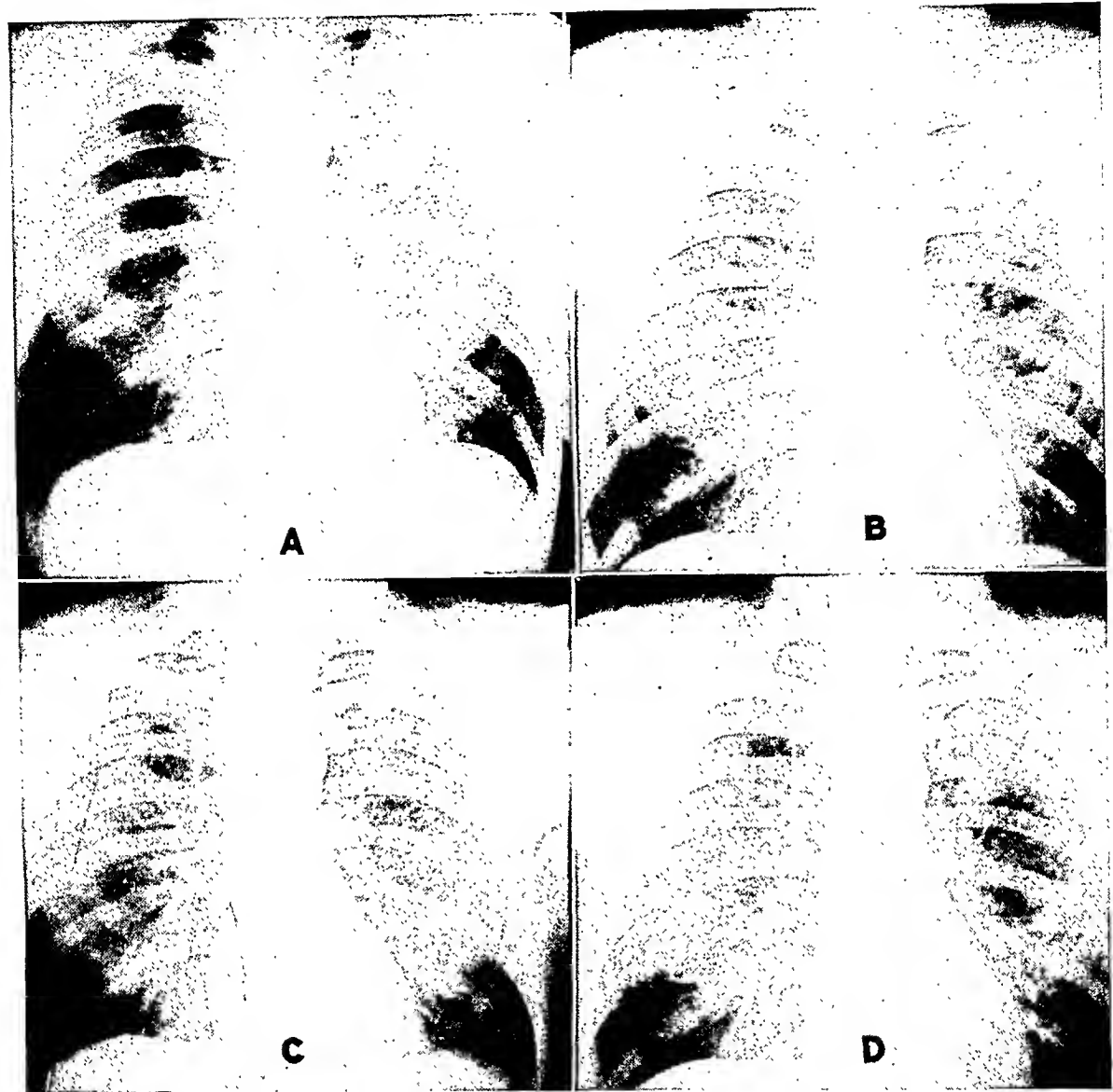


Fig. 36. Case 16: Pulmonary coccidioidomycosis. A. Appearance of chest Dec. 19, 1942: extensive lesions characteristic of coccidioidomycosis. B. Condition of chest five weeks later, showing marked clearing. A small residual area of involvement is still present in the left infraclavicular region. C. Condition of chest in September 1943, when the patient entered our hospital: small residual lesion still present in left infraclavicular area. D. Condition of chest one year after the onset of the disease. The patient was clinically well and the chest was almost clear. He was discharged to duty in January 1944.

Coccidioides immitis, can be recovered from the sputa and gastric washings.

The roentgenologist should bear in mind that there are two types of the disease. The first, which is most frequently encountered, is relatively benign and has been designated as a primary phase. In this stage one sees nodular areas of increased density or atypical, somewhat pneumonic-like consolidations in the lung fields, the latter being not dissimilar from

those seen in so-called virus pneumonias. Thin-walled cavities may be present, which usually close spontaneously. The secondary, or granulomatous phase, although less frequent, is highly fatal and is characterized by mediastinal adenopathy, not unlike that occurring in Hodgkin's disease, and chronic fibrotic pulmonary changes with or without cavitation. Bone lesions, which are likely to occur during this phase, have a bizarre distribution and show a pred-

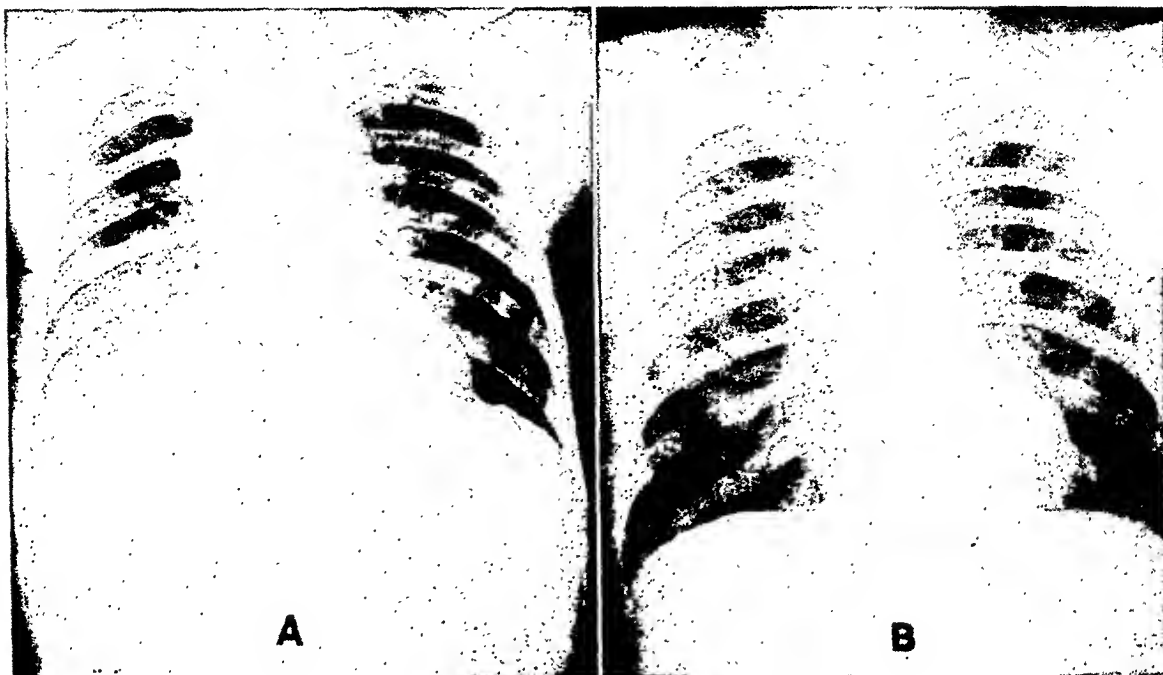


Fig. 37. Case 17: Mediastinal Hodgkin's disease. Chest before (A) and following (B) roentgen therapy.

ilection for pressure points, such as the malleoli, the acromion processes, the olecranon, etc. Miliary dissemination is not infrequently a terminal manifestation of the disease.

An illustrative case of pulmonary coccidioidomycosis is shown in Figure 36. The following is a history of this case.

CASE 16: A 34-year-old soldier was stationed in the Arizona desert. In November 1942, two months after being stationed there, he became acutely ill, with headache, cough, pain in the left side of the chest, mild fever, malaise, and night sweats. These symptoms persisted for the next three weeks, at the end of which time erythema nodosum developed. Physical examination revealed numerous coarse râles through the left chest. The blood sedimentation rate was 30 mm. for the first hour. Within the next few days the patient became relatively asymptomatic and afebrile. He was discharged Feb. 1, 1943, the sedimentation rate having dropped to 15 mm. for the first hour. He was again hospitalized in July 1943, because of recurrent pain in the left chest, and was transferred to Percy Jones General Hospital Sept. 7, 1943. He was afebrile at this time and the blood count and sedimentation rate were normal. Physical examination revealed nothing abnormal. In October 1942, two weeks before the beginning of the illness, the coccidioidin skin test was negative. The test was repeated at the time erythema nodosum developed, when it was found to be strongly positive. It was again repeated at this hospital, ten months later, and was

still positive in 1:100 dilution. The tuberculin test at this hospital was also positive. Repeated studies of the sputa and gastric washings both for tubercle bacilli and *Coccidioides immitis* were negative. The patient returned to duty, apparently cured, Jan. 15, 1944.

Hodgkin's disease has been seen comparatively frequently, as one would expect in this age group. The response to radiation therapy, except in the acute form, has been satisfactory, at least temporarily.

A typical case of mediastinal Hodgkin's disease is shown before and after treatment in Figure 37. The history was as follows.

CASE 17: A 26-year-old private in the Air Force was admitted to Percy Jones General Hospital in August 1943. He gave a history of loss of weight and weakness extending over a period of two and one-half months. The symptoms appeared while he was on duty in North Africa. He experienced sharp mid-abdominal pain. In the Station Hospital he was found to have an irregular fever and a rapid sedimentation rate.

The patient was critically ill, with a tense, distended abdomen. X-ray examination showed a large mediastinal mass characteristic of Hodgkin's disease. Bilateral supraclavicular lymph nodes were present. Between Aug. 7 and Dec. 1, 1943, heavy radiation was given to the mediastinum and abdomen anteriorly and posteriorly. The patient responded promptly to treatment and was discharged to a Veterans' Facility for further care in

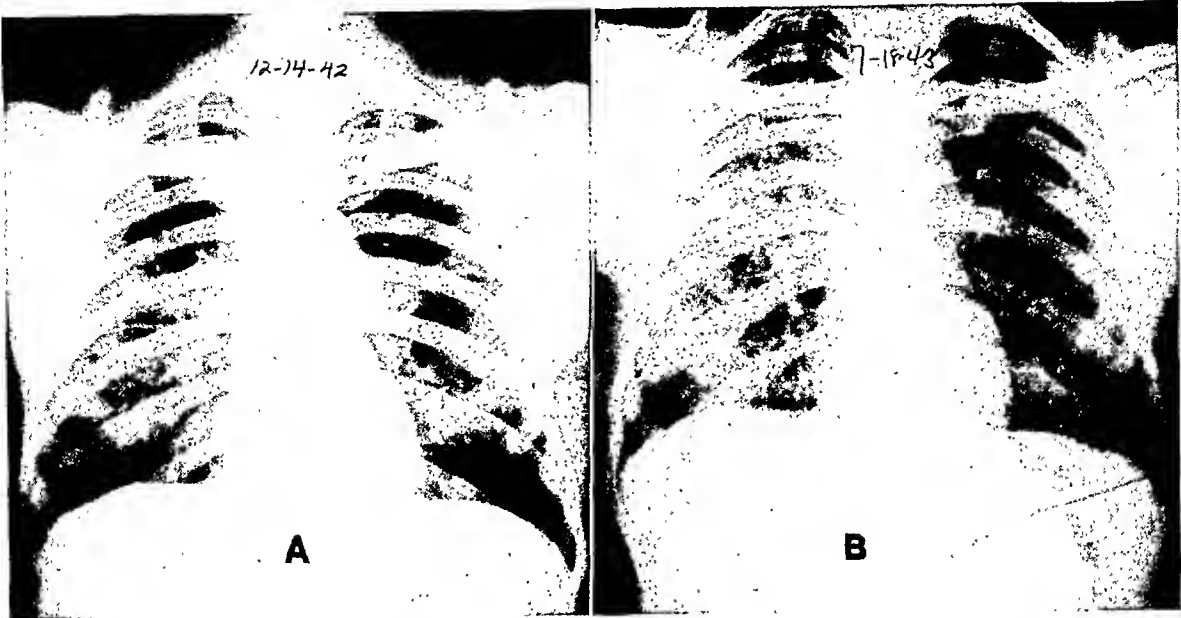


Fig. 38. Case 18: Typical case of Boeck's sarcoid. A. Condition of chest in December 1942, with marked enlargement of lymph nodes. B. Condition of chest in July 1943. The mediastinal nodes are still enlarged, there is reaction about the bronchi on the right, and the right lung field is definitely more dense than the left.

December 1943, at which time he seemed to be in excellent physical condition.

Several cases of Boeck's sarcoid have been encountered. One is shown in Figure 38.

CASE 18: A 31-year-old Negro sergeant first reported for sick call in June 1942, because of weakness and right upper quadrant distress. He reported four times on sick call between June and November. On Nov. 8 he had much bleeding from the gums and on one occasion there was a profuse spontaneous gingival hemorrhage at night. On Nov. 11 he fainted, due to hematuria, and was placed on the critical list. Multiple transfusions brought about apparent recovery by Dec. 5. Ten platelet counts showed a range between 20,000 and 124,000. On Nov. 11, x-ray examination showed enlargement of the hilar lymph nodes, and a presumptive diagnosis of lymphoblastoma was reached. Nine chest films made at intervals thereafter showed a steadily increasing change in both lung fields, indicating a progression of the disease. Eye consultation showed a bilateral hemorrhagic retinitis. Biopsy of axillary lymph nodes was unsatisfactory. Tuberculin skin tests were negative. The transfer diagnosis on admission to this hospital was purpura hemorrhagica, retinitis, and iridocyclitis. Our chest findings showed a mediastinal mass, increase in the truncal markings, and hypo-aeration of the right lung field. Biopsy of an enlarged cervical lymph node showed sarcoidosis with complete replacement of the node by a granuloma exhibiting no evidence of caseation. A diagnosis of Boeck's sarcoidosis was made. The



Fig. 39. Case 18: Boeck's sarcoid. Section showing typical formation of conglomerate tubercles composed of epithelioid cells with compression of intervening lymphoid structures. No evidence of caseation and no tubercle bacilli found on section.

course was that of progressive improvement with gain in weight. The only complaint was slight diminution of vision and a morning cough. The patient was discharged to his home in excellent health, although the lung fields were still definitely abnormal.

Three carcinomas of the lung seen have all been of unusual interest, representing

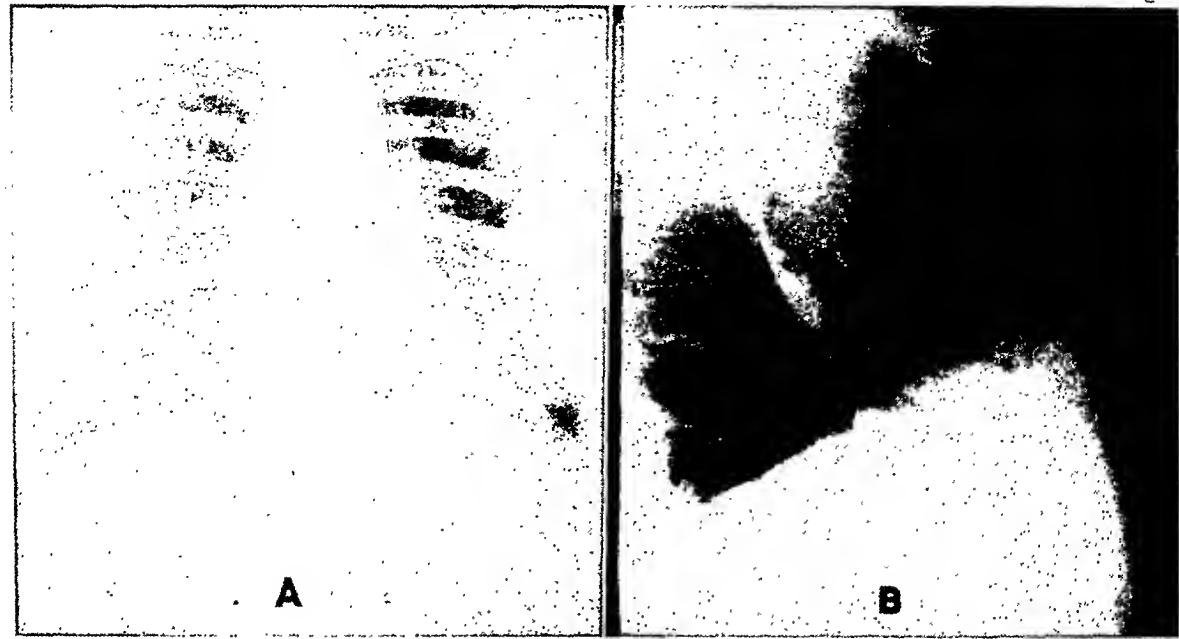


Fig. 40. Case 19: Carcinoma of lung. A. In this view the chest apparently is essentially normal. B. The esophagus is seen filled with contrast material. It appears to be flattened, twisted, and displaced somewhat posteriorly. The surrounding area is quite dense, suggesting the possibility of a new growth in this region. A primary bronchiogenic carcinoma was later demonstrated.

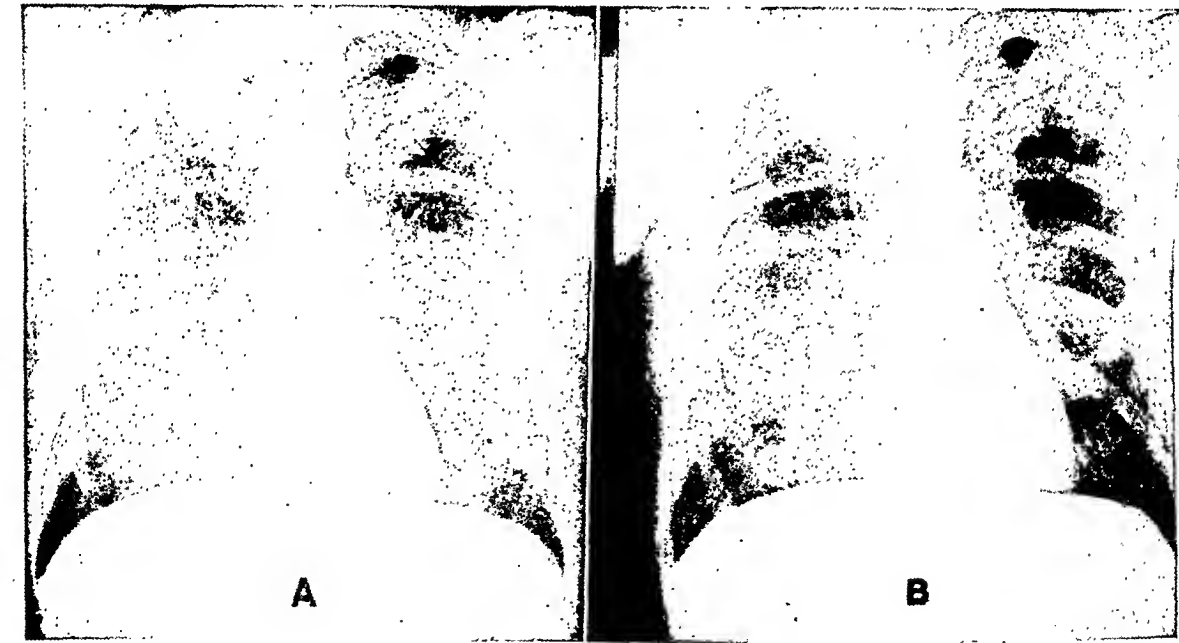


Fig. 41. Case 20: Carcinoma of lung. A. Condition of chest in August 1943. There is a cavity in the right upper lobe with a dense shadow above it, later shown to be due to a carcinoma. B. Roentgenogram made two months later. The tumor has increased greatly in size and there is now infiltration in the left apex as well. The latter may well be due to spread of a tuberculous infection, for tubercle bacilli were demonstrated repeatedly in the sputum.

distinct types. The histories and findings follow.

CASE 19: A 45-year-old sergeant with twenty-seven years of active military service was hospital-

ized because of hoarseness, dyspnea, and wheezing, of six months' duration. The left vocal cord was paralyzed. The patient was transferred to this hospital in August 1943, with a diagnosis of chronic bronchitis. Our x-ray examination showed the

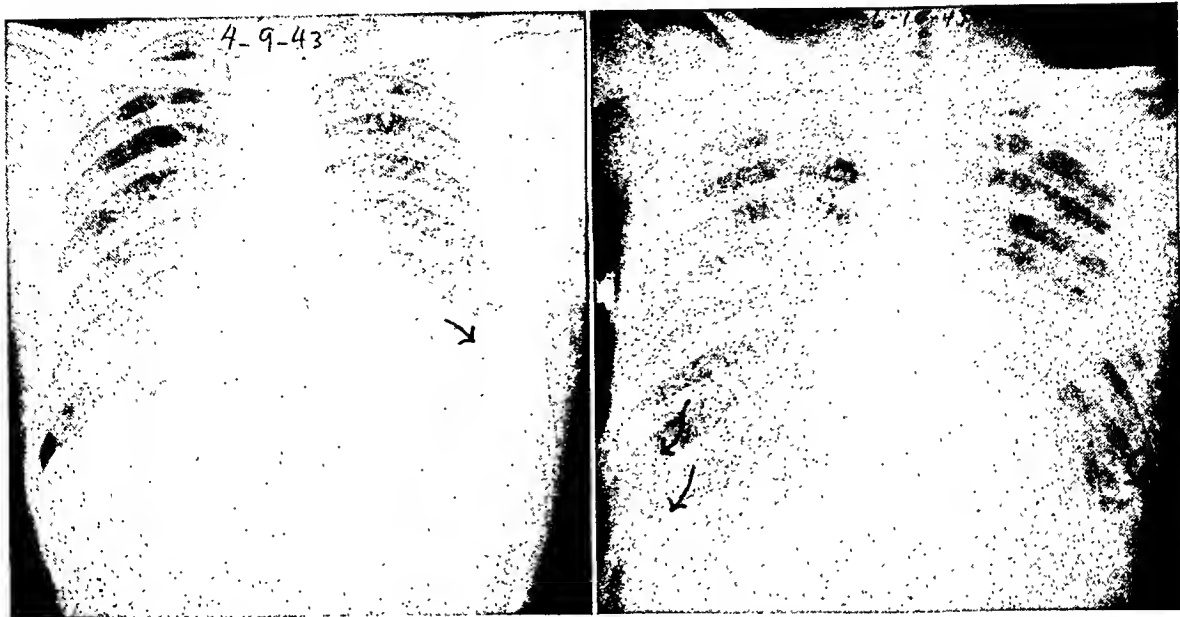


Fig. 42. Case 21: Carcinoma of lung. Condition of chest April 9, 1943, and June 10, 1943. There is diffuse miliary infiltration throughout the lung fields with a bilateral pleural effusion. The infiltration was shown at autopsy to be due to a diffuse carcinomatosis.

esophagus to be slightly displaced and rotated, as shown in Figure 40. There was a suggestion of an area of increased density posterior to the arch of the aorta. The sedimentation rate was slightly increased. Bronchoscopy showed evidence of extrinsic pressure indenting the bronchus of the left upper lobe, but no intrinsic tumor was found. It was our impression that a tumor in the mediastinal area was responsible for the deformity of the esophagus shown. In October, enlarged supraclavicular nodes were observed, and a biopsy revealed a squamous-cell carcinoma.

The patient was given deep radiation therapy over the upper mediastinum and upper part of the left side of the chest, the total dosage being 2,000 r measured in air to each of two mediastinal ports and 1,800 r to each of two supraclavicular ports. The enlarged supraclavicular nodes regressed promptly and there was definite improvement in the patient's breathing. He did fairly well until March 1944, when he suddenly had a massive pulmonary hemorrhage and died. At autopsy there was found to be infarction of the left upper lobe due to thrombosis of the pulmonary vein by invading tumor tissue. As a result, a varix had formed, which had ruptured into the bronchus and caused death.

In this case the roentgen findings were minimal but stimulated a careful search for a pulmonary new growth. Had the esophagus not been examined with barium and the persistent deformity not been discovered, the patient might have been dismissed as showing no evidence of disease.

CASE 20: A 43-year-old corporal was admitted to Percy Jones General Hospital June 24, 1943. His induction films had been considered normal. In February 1943, he suffered from what was diagnosed as pneumonia involving the right upper lobe. An x-ray examination at that time revealed a cavity in the right apex, which was considered to be of tuberculous origin. The patient was asymptomatic until May 1, 1943, when a chronic non-productive cough developed. The sputum was blood-tinged. Pain in the right shoulder and right arm then appeared. Examination showed a clubbing of the fingers, which was said to have been present since 1935. The teeth were examined and multiple abscesses were found. Extraction of the teeth was followed by relief of the pain in the shoulder and arm. The patient gave a further history of having worked in a tuberculosis sanatorium for five months prior to his induction into the Army.

On admission to our hospital in June 1943, the white blood cell count was 25,000. Tubercle bacilli were found in the sputum, together with fusiform spirochetes and yeast. Roentgen examination revealed a cavity in the right apex, as shown in Figure 41. It was surrounded by a dense homogeneous shadow, the widest portion of which extended from the cavity into the apex, forming a peculiar cap-like mass above the cavity. For this reason our conclusions were that we were probably dealing with a cavity in a malignant tumor rather than a tuberculous cavity. The lesion increased rapidly in size during the patient's stay in our hospital. An exploratory thoracotomy was done, at which time an inoperable carcinoma of the right upper lobe was found. Following exploration, a culture of the spu-

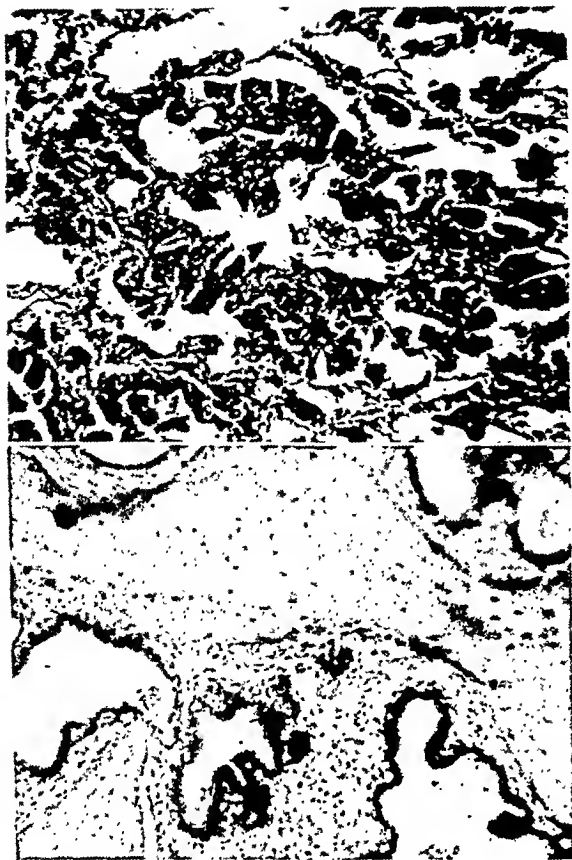


Fig. 43. Case 21: Multicentric carcinomatosis of the lung. The section above reveals papillary adenocarcinoma growing in branching fronds and finger-like projections into the air spaces of the alveoli. That below shows metastatic growth in a lumbar vertebral body. There has been complete replacement of the marrow by tumor cells and fibrous stroma. The bony elements apparently are still intact.

tum again revealed tubercle bacilli. The biopsy showed an undifferentiated squamous-cell carcinoma. This had evidently developed in the region of an old tuberculous infection.

CASE 21: A 41-year-old private was admitted to a station hospital in June 1943, because of cough, fever, and pain in the inguinal regions, which was relieved by heat and massage. Roentgenograms made on April 6 and 18, 1943, showed miliary densities in both lung fields and a massive pleural effusion on the right. The following month a large amount of fluid was observed on the left, shown by thoracentesis to be serosanguineous. On admission to this hospital in June, the main complaints were constipation and right upper quadrant pain. The liver was enlarged. The appearance of the chest is shown in Figure 42.

Physical examination showed cyanosis of the nail beds. The mediastinum was deviated to the left by fluid in the right pleural space, and there was pitting edema of the legs. Many collateral veins were present on the thighs and abdomen. During

the first two weeks in this hospital purulent blood-tinged sputum was raised. The patient suffered from recurrent pleuritic pain, first on one side and then the other. On July 13, 1943, he complained of coldness and numbness of the left hand. On July 16 he became aphasic and showed right facial weakness. Death occurred July 27, 1943.

Necropsy revealed diffuse carcinomatosis of the lungs, apparently primary in the right main stem bronchus. There was infarction of the left lower lobe, with necrosis, suppuration, and encapsulated empyema. Thrombosis of the common iliac and femoral veins and distal portion of the inferior vena cava was found. Thrombo-endocarditis of the mitral and tricuspid valves was present, with embolism of the splenic artery, left renal artery, left radial artery, the cerebral arteries, and anterior descending branch of the left coronary artery. There were small metastatic lesions in the liver, adrenals, kidney, and pancreas.

This thrombophilic diathesis with cancer has been known for a long time. It is thought by some to be the result of cancer toxins acting on the capillary endothelium or on the mast cells of Ehrlich, which form heparin.

We have seen one case of blastomycosis, which is of unusual diagnostic interest. The history and findings are as follows:

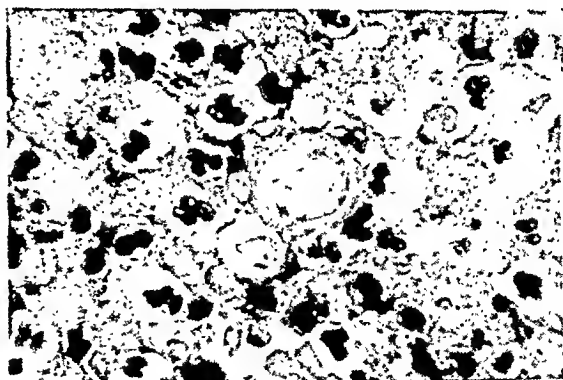


Fig. 44. Case 22: Blastomycotic osteomyelitis showing budding yeast cell within purulent exudate.

CASE 22: A 31-year-old private, first class, with six months' service gave a history of pain on breathing, associated with a dry, hacking cough, in May 1943. Consolidation was demonstrated in the lung fields at this time. The patient was not acutely ill; the temperature was normal, and the white blood cell count was 13,000. A diagnosis of atypical pneumonia was made. The patient began to lose weight, the cough became productive, and the temperature occasionally rose to 99.6. The sputum was blood-streaked on three occasions, but was repeat-

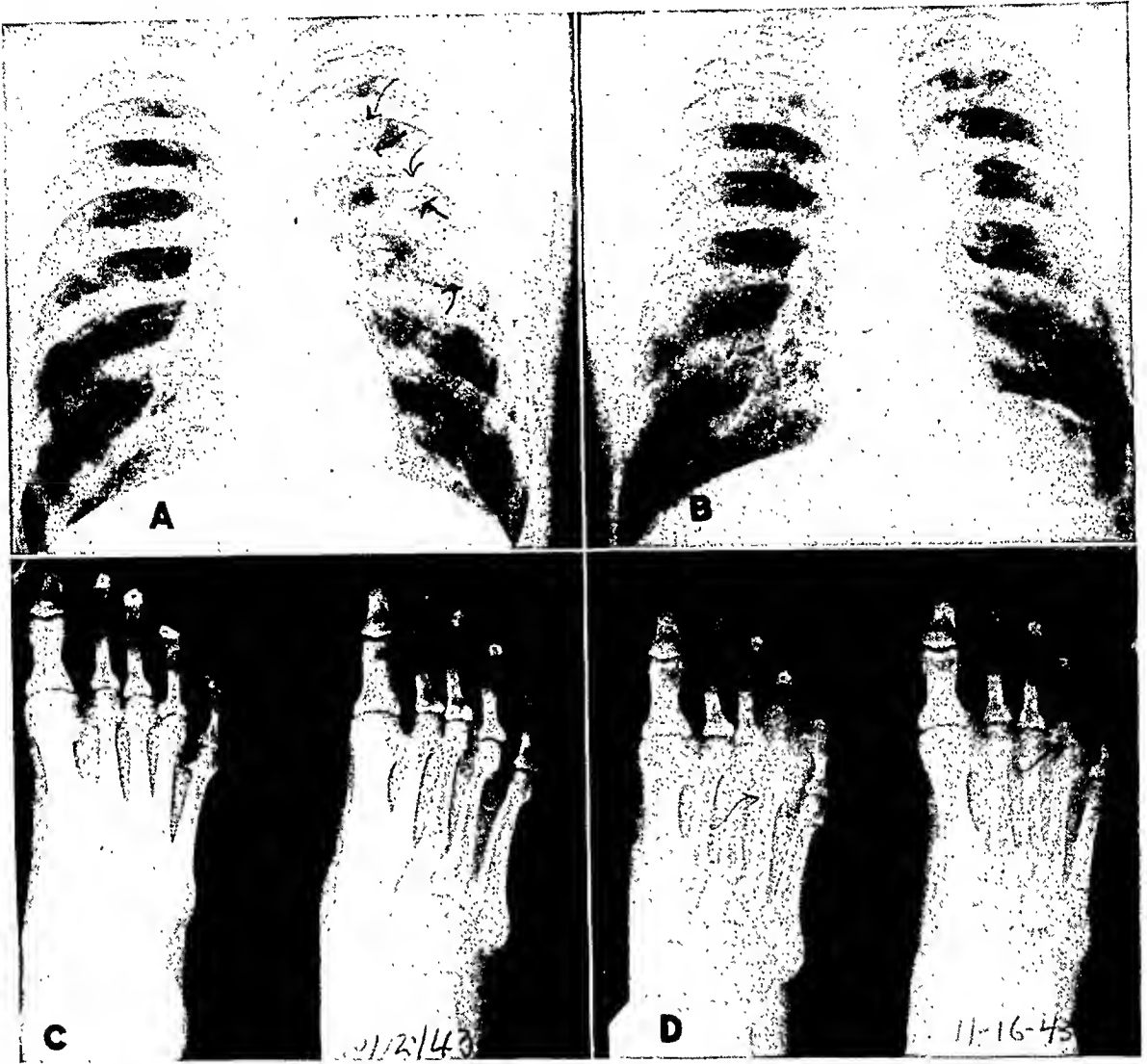


Fig. 45. Case 22: Blastomycosis. A. Mass lesion lateral to the arch of the aorta in a patient later shown to have a blastomycosis in the right foot. B. Condition of the chest seven months later, when the patient was apparently clinically well. C. Two views of the right foot when the patient exhibited swelling and tenderness in the region of the distal end of the fourth metatarsal. No abnormalities were demonstrated. D. Condition of foot approximately five weeks later. At this time there was extensive destruction of the proximal phalanx of the fourth toe and the distal end of the fourth metatarsal. There was some periosteal reaction along the medial margin of the distal half of the fourth metatarsal. Blastomyces were found in the material removed at operation.

edly negative for tubercle bacilli. The blood sedimentation rate ranged between 55 and 75 mm. during the first hour.

When the patient was first seen here, an irregular mass was found just to the left of the mid-line in the region of the arch of the aorta. It did not seem characteristic of a primary carcinoma nor was it characteristic of a tuberculous infection. A bronchoscopy was done and small ulcerations were found in the left main bronchus that were considered characteristic of an endobronchial tuberculous infection. Acid-fast organisms were found in one gastric washing. The ulcers were cauterized, and progressive healing of the mucosa took place.

On Oct. 1 the patient first began to complain of discomfort in the region of the base of his fourth toe, and swelling and redness were noted in this area. The temperature was 99.2°. The white blood cell count was normal. X-ray examination of the metatarsal phalangeal area was negative. On October 15 purulent material was aspirated from the area of swelling about the distal end of the fourth metatarsal, but the cultures were sterile. X-ray examination, Nov. 16, showed extensive bone destruction involving the proximal phalanx of the fourth toe and the adjacent part of the distal end of the fourth metatarsal. Some periosteal thickening was present. Other parts of the skeletal system

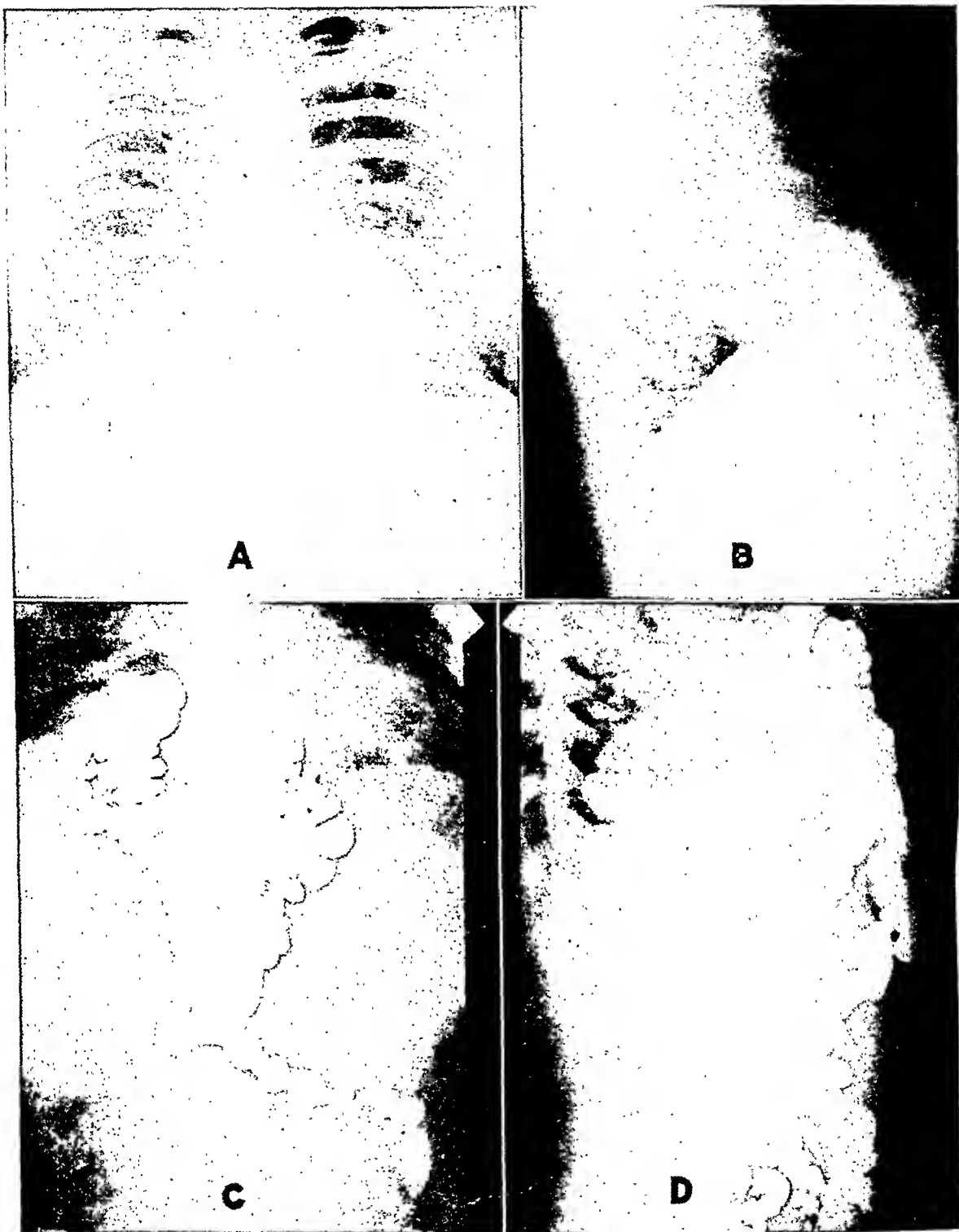


Fig. 46. Case 23: Diaphragmatic hernia. Films of the chest (A and B) showed a sharply circumscribed shadow lateral and anterior to the right cardiac border. It was thought that this shadow indicated the presence of a diaphragmatic hernia, and this was shown to be the case during the examination of the gastro-intestinal tract (C and D). The stomach and small bowel were below the diaphragm, but portions of both the cecum and what would ordinarily be the splenic flexure and colon were in the hernial sac which lay in the anterior part of the thorax.



Fig. 47. Case 24: Gastro-intestinal examination showed all of the stomach and a large part of the left half of the colon to be in the left side of the thorax. There was still a question whether the displacement of the stomach and colon might be due to an eventration rather than a diaphragmatic hernia and for this reason a pneumoperitoneum was done. This resulted in a partial pneumothorax, proving the presence of a communication between the pleural and peritoneal spaces.

were examined and found to be normal. On Dec. 6 there was further evidence of destruction of the fourth metatarsal head of the adjacent portion of the fourth phalanx. A resection of the involved bone was done and cultures of the material removed showed blastomyces. Prior to this the patient had been placed on sulfadiazine. It was planned to desensitize him to the organism found, but he improved so rapidly that this was not done. At the present time the chest is essentially normal except for slight fibrosis in the left root region. There is no pain in the foot, and there has been no further evidence of destruction. From the clinical point of view the patient appears to be well. It seemed evident that the lesions in the chest and foot were of a similar nature. The lesion in the chest before and after treatment and the lesions in the foot are shown in Figure 45.

THE GASTRO-INTESTINAL TRACT

Relatively few abnormalities of the esophagus have been found. Among those seen have been a few diverticula, two peptic ulcers, and a very few cases of cardiospasm. There have been no malignant tumors. Esophagoscopy has been performed in all cases where suspicious

changes have been observed and has been a decided aid in diagnosis, particularly in the ulcers.

CASE 23: A large hernia through the anterior portion of the diaphragm is shown in Figure 46. A 19-year-old sergeant was transferred to this hospital because of a two-year history of cough with expectoration. There was slight dyspnea on exertion. Examination showed a hernia through the anterior portion of the diaphragm. Quite a large portion of the colon was in the sac of the hernia. At operation the hernial sac was found to consist of a single chamber, but the round ligament of the liver was invaginated, partially dividing it into two compartments.

We saw one case in which the differential diagnosis was of interest, being between an eventration and a diaphragmatic hernia (Fig. 47). The history and findings follow:

CASE 24: A 26-year-old staff sergeant was transferred to this hospital with a history of having been injured when sixteen years of age by a truck turning over. A dead horse which was in the truck fell on him, causing considerable trauma of the chest and abdomen. He suffered from pain and tenderness



Fig. 48. Case 25: A. Lateral decubitus film showing the presence of extensive spontaneous pneumoperitoneum together with distended loops of bowel showing fluid levels. B. Partial filling of the colon with contrast material done elsewhere. The descending colon is on the right. The transverse portion is obstructed. The appearance in the area of obstruction suggests pressure from without rather than obstruction due to an intrinsic lesion. The large gas shadow in the left side of the abdomen was later shown to be due to a distended cecum lying in a hernial sac behind the lesser peritoneal cavity, several perforations of the cecum being present. C. Condition of the abdomen at the time the patient entered our hospital. a. Gas free in peritoneal space. b. Gallbladder.

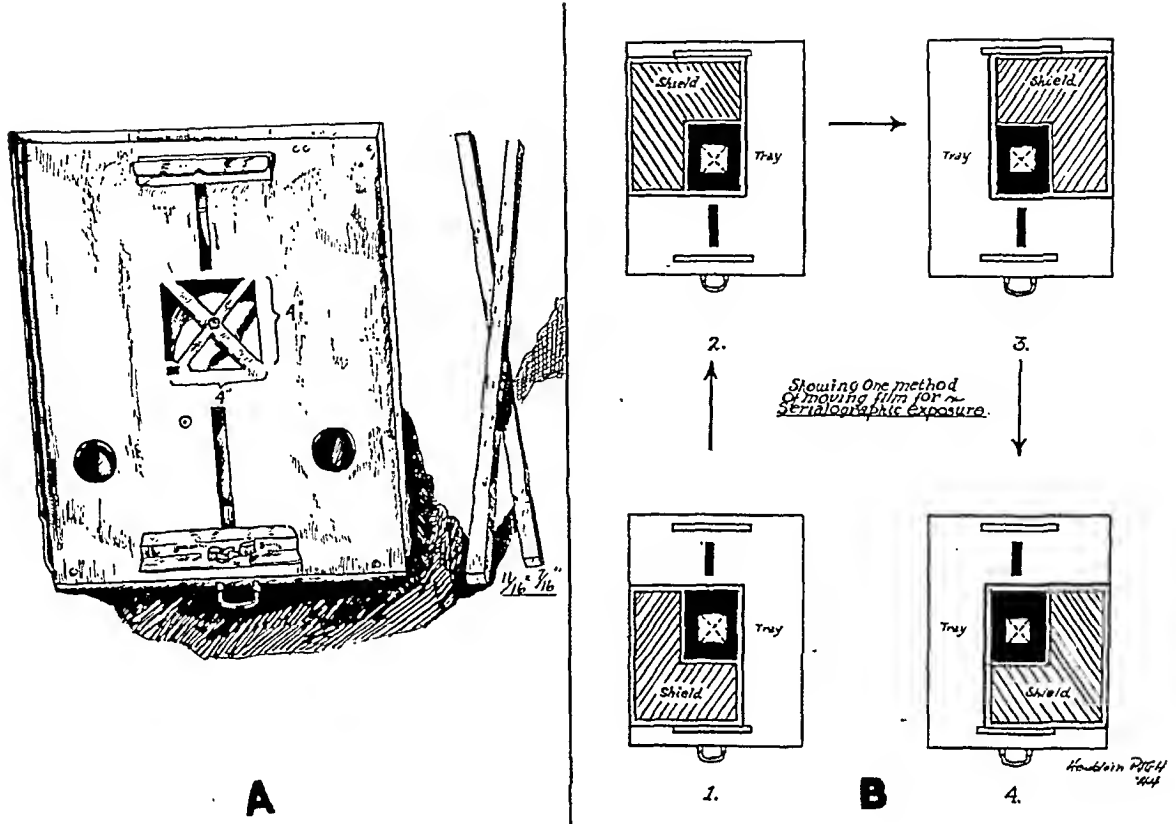


Fig. 49. A. Drawing showing the opening cut in the tray of the Bucky diaphragm in order to permit fluoroscopic centering of the part being examined. The small sticks at the right are required in order to insure accurate centering of a 10 X 12-in. cassette. B. Showing use of a lead shield and method of shifting the cassette in order that four serial exposures, each 5 X 6 in., can be secured.

and was in bed for four or five days. He was then well for about six years, after which he began to suffer from attacks of abdominal pain, without nausea or vomiting. On three occasions a diagnosis of appendicitis was made, but the patient was not operated upon. The attacks became less frequent and he was quite well until eighteen months after entering the Army, when he again began to suffer from abdominal pain. He was working as an airplane mechanic and the pain was most severe when he bent over in a cramped space. On one occasion it was so intense that he fainted. A lesion was found in the left side of the chest by x-ray and the patient was evacuated from overseas and sent to our hospital. The greater part of the stomach and a portion of the left side of the colon were seen to be well above the usual level of the left side of the diaphragm. It was impossible to be certain whether we were dealing with an eventration or a diaphragmatic hernia, and pneumoperitoneum (Fig. 47) was done. The gas passed from the abdomen into the thorax, causing a partial pneumothorax and proving that there was a defect in the left side of the diaphragm. It is a question whether this defect was developmental in origin or the result of trauma. The history would suggest a traumatic origin.

One spontaneous pneumoperitoneum was encountered due to rupture of the cecum secondary to an internal hernia.

CASE 25: A 23-year-old technician, fifth grade, was transferred to this hospital with a history of abdominal pain and swelling of the right testicle first manifest two weeks prior to admission. The white blood cell count was moderately elevated and there had been some nausea and vomiting immediately prior to admission. Upon physical examination the abdomen was found to be moderately distended and there was a palpable mass in the right side. Films showed an extensive pneumoperitoneum, together with a circumscribed gas shadow in the upper half of the abdomen which seemed indicative of gas confined in a closed space, possibly in the lesser peritoneal cavity. The above findings are shown in Figure 48.

It was obvious that there had been a perforation of some part of the gastro-intestinal tract. The patient was operated upon immediately. The cecum was found to be tremendously dilated and perforated. It lay in a hernial sac behind the lesser peritoneal cavity, which accounted for the circumscribed area of decreased density in the upper abdomen.

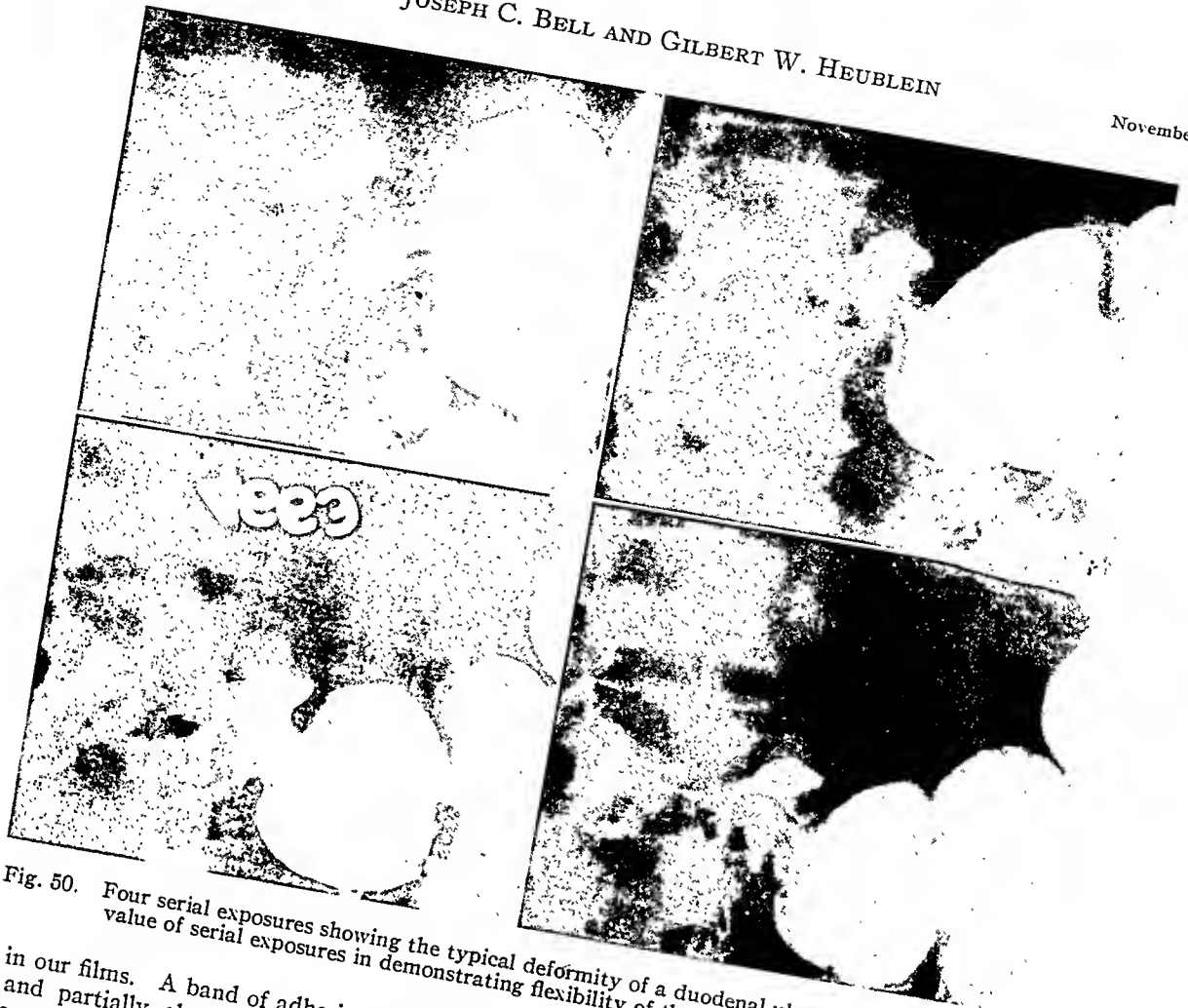


Fig. 50. Four serial exposures showing the typical deformity of a duodenal ulcer and illustrating the value of serial exposures in demonstrating flexibility of the walls of the stomach.

shown in our films. A band of adhesions extended across and partially obstructed the small bowel. The cecum, part of the ascending colon, and the terminal six inches of the ileum were resected, and the terminal end of the remaining portion of the ileum was anastomosed to the proximal end of the remaining portion of the colon. The post-operative course was stormy, but the patient made a satisfactory recovery.

Peptic ulcer is a frequent and serious cause of disability in the Armed Services. In a little more than one year we have seen 181 duodenal ulcers and 6 gastric ulcers that from their course were apparently benign, the gastric ulcers accounting for but 3.3 per cent of the entire series. Most of our patients have had an ulcer history prior to induction. Many were asymptomatic at the time of entrance on active duty but symptoms subsequently developed during the training period or under battle conditions. Duodenal ulceration is not compatible with active military service

except in rare instances where the diet and activity can be carefully controlled.

In examinations of the stomach and duodenum we consider an adequate number of films to be of decided aid in diagnosis, using compression over the part under suspicion when indicated and serial exposures routinely. The serial films are secured by means of a special opening in the Bucky diaphragm tray and a lead L-shaped protection shield, shown in Figure 49. This apparatus was arranged by one of us (G. W. H.) and permits fluoroscopic centering and the making of four exposures on each 10 X 12-inch film. Such serial exposures are of great value, providing a permanent record showing whether or not the part under observation is flexible, and, if a defect is present, whether or not it can repeatedly be demonstrated. These exposures are supplemented by others showing the entire stomach in various projec-



Fig. 51. Eight serial exposures showing varying degrees of filling of the duodenal cap, demonstrating the characteristic deformity of an ulcer, particularly when the cap is almost empty. In our work eight exposures of this type are made in the average case.

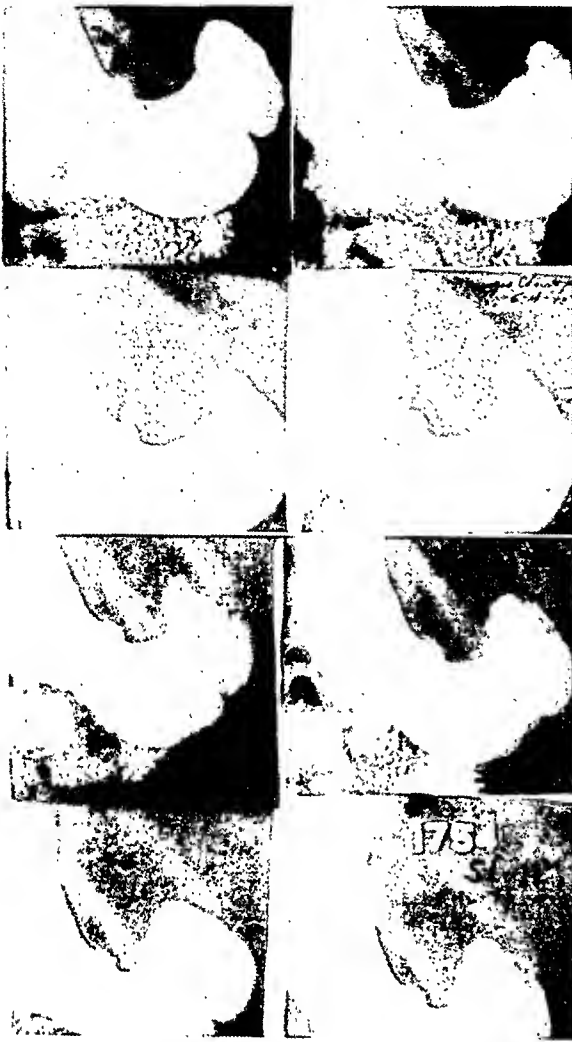


Fig. 52. Case 26: Diffuse carcinomatosis of the stomach. Four serial exposures of the stomach done at each of two examinations with an interval of six weeks. The ulcer is in the anterior wall of the stomach just proximal to the incisura angularis. It will be noted that the posterior wall of the stomach is flexible, but that no evidence of peristaltic waves can be seen in the anterior wall. The ulcer showed no improvement under strict medical management, and operation revealed a very diffuse submucosal carcinomatosis, the only abnormality in the mucosa being at the point of ulceration.

tions. Serial films made by the above method showing typical duodenal ulcers are seen in Figures 50 and 51.

Gastroscopy is available in this hospital and its use is encouraged by the staff of the X-Ray Department. It is an excellent check on the correctness of our observations. We have not found it possible to diagnose gastritis, either erosive or of other types, with any degree of accuracy, although this diagnosis can be made by

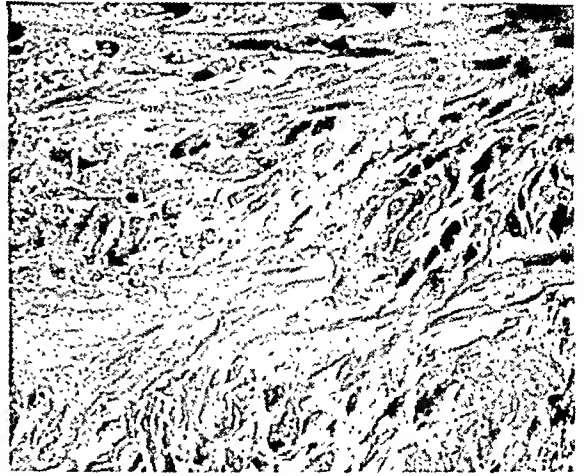


Fig. 53. Case 26: Diffusely infiltrative carcinoma of the stomach. Section showing infiltration between muscle fibers.

gastroscopy. Thus far no ulcers have been demonstrated by gastroscopy that had not already been detected by roentgen examination, although it is well recognized that ulcers may at times be gastroscopically demonstrated when they have not been revealed by the roentgen ray. The converse is also true.

The following case histories and findings are of interest:

CASE 26: A 23-year-old technician, fifth grade, was transferred to our hospital from the South Pacific with a history of having been well until March 1943, when he began to suffer from epigastric distress which was burning in character and was constant. Some relief resulted from hospitalization and intensive ulcer therapy. An x-ray examination while the patient was still in the South Pacific area showed a small circumscribed ulcer in the anterior wall of the stomach just off the lesser curvature, slightly above the incisura angularis. This ulcer was again demonstrated in our hospital and is shown in Figure 52. The gastric acidity was normal, the hemoglobin 106 per cent, and the white cell count was normal. Gastroscopy was done on three occasions, and a circumscribed ulcer was seen in the anterior wall of the stomach in the area described above. There was no abnormality of the surrounding mucosa, and in all other parts of the stomach the mucosa was normal. Rigid ulcer therapy was instituted, without any appreciable improvement, and after three weeks a gastric resection was done. Examination of the excised portion of the stomach showed diffuse carcinomatous infiltration beneath the mucosa throughout. The mucosa was normal except for an area of ulceration. The patient died two days after resection, due to pneumococcus septicemia.



Fig. 54. Case 27: Carcinoma of the stomach. Films made at two examinations both demonstrate a constant deformity of the greater curvature side of the middle third of the stomach. That reproduced in A shows definite evidence of ulceration, which was demonstrated at gastroscopy and at operation.

CASE 27: A 24-year-old technician, fifth grade, was transferred to this hospital with a diagnosis of carcinoma of the stomach. He was well until the summer of 1943, when he began to experience weakness and found that he became fatigued easily. In September he noticed a dull girdle-like pain when he stooped over. In October the stools were tarry. X-ray examination at the station hospital showed an ulcerating lesion of the greater curvature of the stomach considered to be malignant in nature. Our x-ray findings were the same as those of the station hospital. The films made at the two examinations are shown in Figure 54. The gastroscopic examination showed a fungating mass with an ulcerated center. On Jan. 18, 1944, a subtotal gastric resection was done and an anaplastic infiltrating carcinoma Grade III was found. Some involvement of the regional lymph nodes had occurred.

Small bowel studies are done in all cases where such an examination seems indicated, particularly in patients suffering from gastro-intestinal symptoms without demonstrable cause in the colon or upper gastro-intestinal tract and in those with unexplained diarrhea or periumbilical pain. We have seen a number of patients with

serious disturbances in the physiology of the small bowel. Some were obviously those of a deficiency state. An illustrative case is as follows:

CASE 28: A 22-year-old private, first class, was inducted in November 1940. He was well until September 1941, when in the European theater he was hospitalized because of nausea and vomiting. He was discharged after a period of one week but began to lose weight. By October 1942 he had lost approximately 50 pounds. He felt weak and was unable to do his work. In April 1943, he was hospitalized because of an intermittent diarrhea and was then returned to this country and sent to our hospital. The physical examination here was largely negative except for severe emaciation. The blood pressure was 90/70. There was a flat oral glucose tolerance curve and an excessive amount of fat was present in the stools. An x-ray examination showed a very considerable disturbance in the physiology of the small intestine. The walls seemed to lack flexibility and the bowel was tubular in appearance. Numerous areas of decreased density characteristic of polypoid changes in the mucosa were present along the margins of the bowel. Our findings are shown in Figure 56. A blood examination showed nothing that was definitely abnormal



Fig. 55. Case 27: Drawing made during gastroscopy, showing a typical carcinoma with a central area of ulceration corresponding to the changes demonstrated by x-ray.

except that the serum calcium was low. The patient was treated conservatively with a high-vitamin diet, large doses of liver extract, and rest. During a period of four months' observation here he showed marked improvement and gained 25 pounds in weight. The fat content of the stool became normal and our x-ray examination showed some improvement in the appearance of the small intestine. The patient was discharged to the Veterans' Facility for further care. The diagnosis here was chronic enteritis, non-suppurative.

The Miller-Abbott tube has been used in some cases of small bowel obstruction with gratifying results. An illustrative case follows:

CASE 29: A 22-year-old private, first class, was wounded in the abdomen while in the South Pacific area in January 1943; ten perforations of the bowel were said to have been found and were closed. He also received a wound in the right shoulder at the same time, which healed promptly. While he was in an evacuation hospital, the hospital was bombed and the patient was wounded in the hand, but he recovered from this promptly. He was then transferred to the United States and eventually arrived at our hospital. In April 1943, he began to suffer from cramp-like periumbilical pain, suggesting a partial obstruction. A small bowel examination revealed a loop in the region of the umbilicus that seemed to be sharply kinked. There was some delay in the passage of contrast material through this area. The symptoms continued and after a few days definite evidence of an obstruction developed.

A Miller-Abbott tube was passed into the small bowel with no difficulty. It progressed normally until it reached the region of the sharply kinked loop, where progress was completely arrested. The bowel was decompressed and after seven hours the tube passed the point of interference and progressed normally down to the cecum. The abdominal discomfort disappeared and in twenty-four hours the tube was removed. There was no further abdominal discomfort, and the patient was returned to limited duty in June 1943. The x-ray findings a month and one week before the obstruction took place and the findings following relief of obstruction are shown in Figure 57.

The double-contrast type of examination of the large bowel is employed in all patients suspected of having polyps and in all those where even a single polyp is demonstrated by sigmoidoscopy. An illustrative case history follows:

CASE 30: A 27-year-old private was transferred to our hospital from a station hospital with a history of rectal bleeding. He had an acute ulcerative colitis three years prior to induction. This lasted for ten months, during which time he lost 50 pounds in weight. He recovered, but one year later there was a recurrence of symptoms and he was sick for three months. On admission here his weight was found to be normal. He was passing three or four stools a day, some containing streaks of blood. Proctoscopic examination showed numerous polyps of the rectum and lower sigmoid and our x-ray examination showed a diffuse polyposis. All parts of the colon were involved. A biopsy taken from one of the polyps in the lower sigmoid was said to have exhibited only chronic inflammation with no evidence of adenomatous change. From the x-ray standpoint, however, the findings seemed characteristic of a diffuse polyposis of the colon. The appearance of the colon was not that usually seen with an ulcerative colitis.

THE URINARY TRACT

A surprising number of lesions of the urinary tract causing serious disability have been encountered in this institution. The most common finding is stones, which in many instances were present, but not recognized, prior to entrance on active duty. The results of treatment have been gratifying in most cases, although in some irreparable damage had taken place before suitable therapy was instituted. The importance of urinary tract stones as a cause of disability in the Army is shown by the fact that 67 patients suffering from this



Fig. 56. Case 28: Chronic non-suppurative enteritis. A and B. Two of a series of films of the small bowel made at our first examination, in September 1943. The bowel is tube-like in appearance. The margins of some of the portions in the right lower quadrant are irregular, and numerous small areas of decreased density are shown having the characteristic appearance of those resulting from polypoid changes in the mucosa. (It will be observed that the film in B is printed in reverse, left to right.) C and D. Two of a series of films made Jan. 17, 1944. These again show the bowel to be very abnormal in appearance, although some improvement is evident.

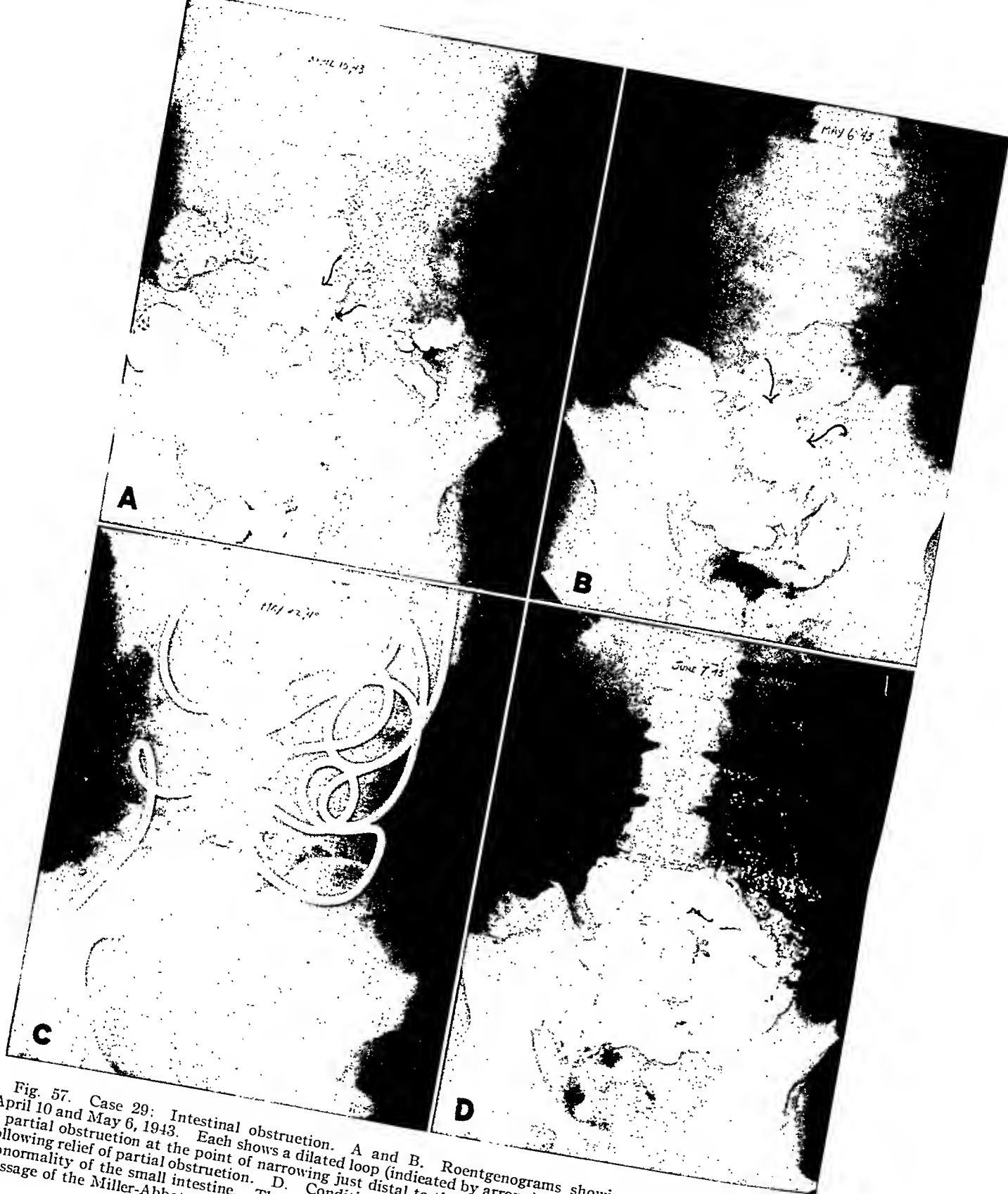


Fig. 57. Case 29: Intestinal obstruction. A and B. Roentgenograms showing condition of the bowel April 10 and May 6, 1943. Each shows a dilated loop (indicated by arrows) considered to indicate the presence of a partial obstruction at the point of narrowing just distal to the dilatation. C. Passage of Miller-Abbott tube following relief of partial obstruction. D. Condition of small bowel June 7, 1943. There is no suggestion of any abnormality of the small intestine. The distended loop demonstrated prior to complete obstruction and to the passage of the Miller-Abbott tube is no longer present.

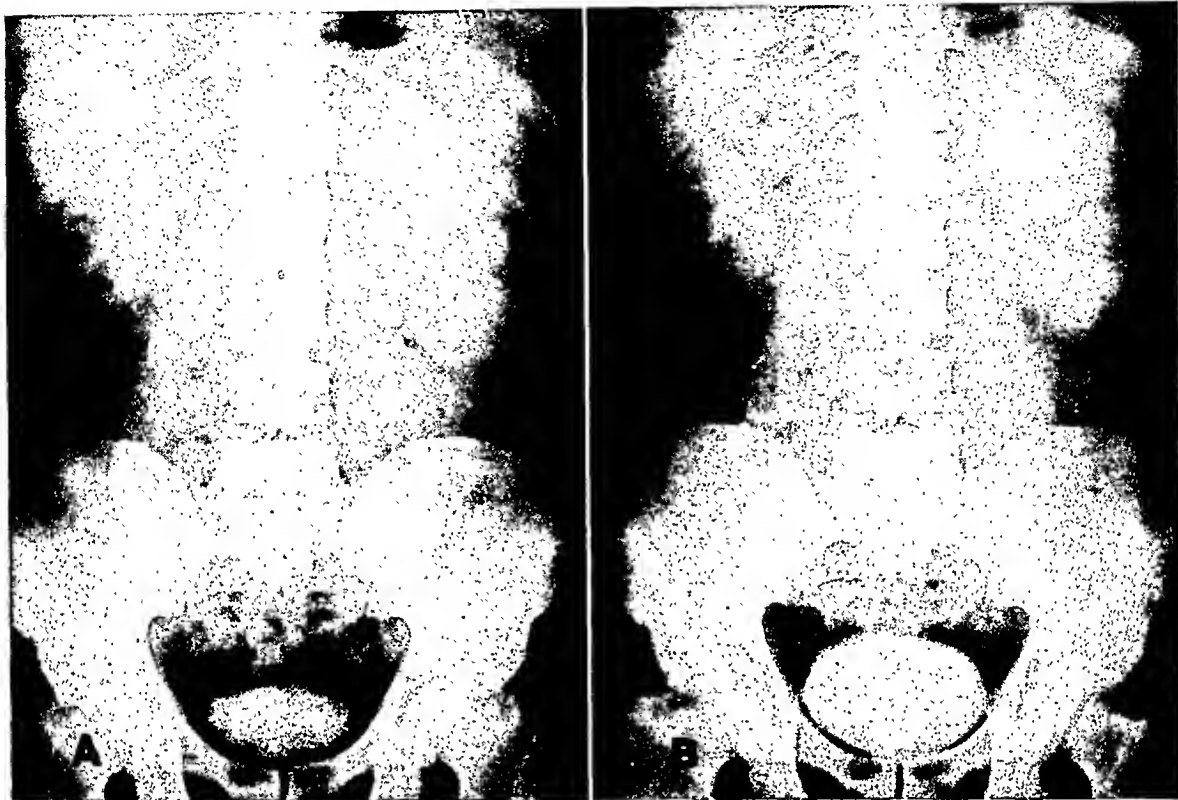


Fig. 58. Case 31: Renal calculus. A. Findings fifteen minutes after the intravenous injection of diodrast. The right side of the tract is satisfactorily shown and apparently normal. The minor calices are beginning to fill on the left and are obviously greatly dilated. The obstructing stone and calcification in the lower pole of this kidney are well demonstrated. B. Findings two hours after the beginning of the examination. All of the opaque material has now passed out of the right side of the tract into the bladder. The minor calices on the left are now well demonstrated, being greatly dilated. It is obvious that the cortex of the kidney is largely destroyed and that the stone is causing the high degree of obstruction.

condition were treated in our institution during the past twelve months. The following is an illustrative case:

CASE 31: A 38-year-old private, first class, was admitted to Percy Jones General Hospital Jan. 26, 1944. He gave a history of passing a small renal stone four years prior to his admission here. Since that time he had suffered dull aching pain in the left renal area at times. This was usually brought on by activity and relieved by rest. On Jan. 24, 1944, he was admitted to a station hospital because of severe chills and fever. Pyuria was noted, and urologic studies demonstrated multiple calculi in the left renal area. This diagnosis was confirmed in our hospital. The calices on the left were greatly dilated. It seemed evident that the cortex was largely destroyed, and a nephrectomy was done Feb. 16, 1944. Considerable induration was found in the perirenal fat, and the cortex was thin throughout. Postoperatively pneumonia developed, but penicillin was given and prompt recovery ensued. The findings in this case are illustrated in Figure 58 and show the importance of making exposures at

intervals for a period of at least two hours in delay or apparent absence of excretion.

Next in frequency and importance have been those lesions having a congenital basis, such as pyelectasis resulting from obstruction by aberrant vessels or bands at the junction of the kidney pelvis with the ureter, or obstructions lower in the urinary tract. The following case history and findings illustrate a relatively rare lesion that may have a congenital basis:

CASE 32: The history and findings in this case were not of importance except for a mild hypertension. At our examination, shown in Figure 59, we demonstrated a cyst-like area that communicated with the superior calix of the left kidney. It was diverticulum-like in appearance. The structures seemed to be entirely normal otherwise, and it was not thought that this finding was significant. Two similar cases were reported by Natvig (2) in 1941.



Fig. 59. Case 32: Cyst-like pocket communicating with the superior calix of the left kidney. The finding was not thought to be of clinical significance. The structures are normal otherwise. This film is of interest in that it was secured by exposing an ordinary x-ray film to direct sunlight through the original film. The exposure time to direct sunlight was thirty seconds. The film was developed in the usual manner and the direct duplication shown in this illustration resulted.

All intravenous urograms are done in the X-Ray Department under the direction of the radiologist, who also does the injection.

This is not an examination that lends itself to routine, the procedure being determined by the findings early in the examination. A so-called preliminary or scout film of the entire tract is always made prior to the injection of the contrast material. The first exposure, with a 14 × 17-in. film, is made approximately five minutes after the injection is completed. Unless contraindicated, compression is then made above the symphysis, using the compression band and a small football in order to block the ureters, the latter being accomplished in most cases. There are some examiners who object to compression, saying that this interferes with the normal dynamics. We are not in agreement with this, for the first film is always made before pressure is applied, and compression makes possible much more satisfactory visualization of the upper urinary tract than is otherwise possible.

Compression is maintained for approximately five minutes, after which stereoscopic views of the upper collecting systems are obtained, on 10 × 12-in. films. Immediately after these are secured, preparation

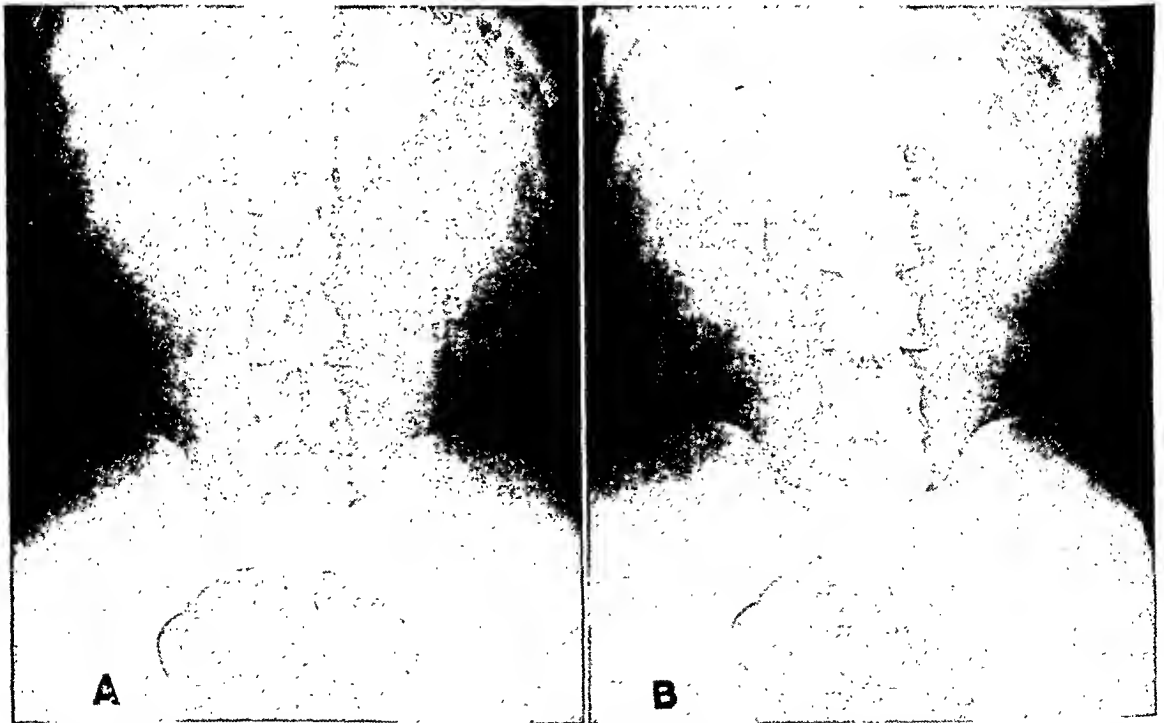


Fig. 60. A. Plain or scout film routinely made in all examinations of the urinary tract. B. Film made approximately five minutes after intravenous injection of diodrast. The upper part of the tract is satisfactorily shown and is obviously normal. A small amount of opaque material was in the bladder when this film was made.

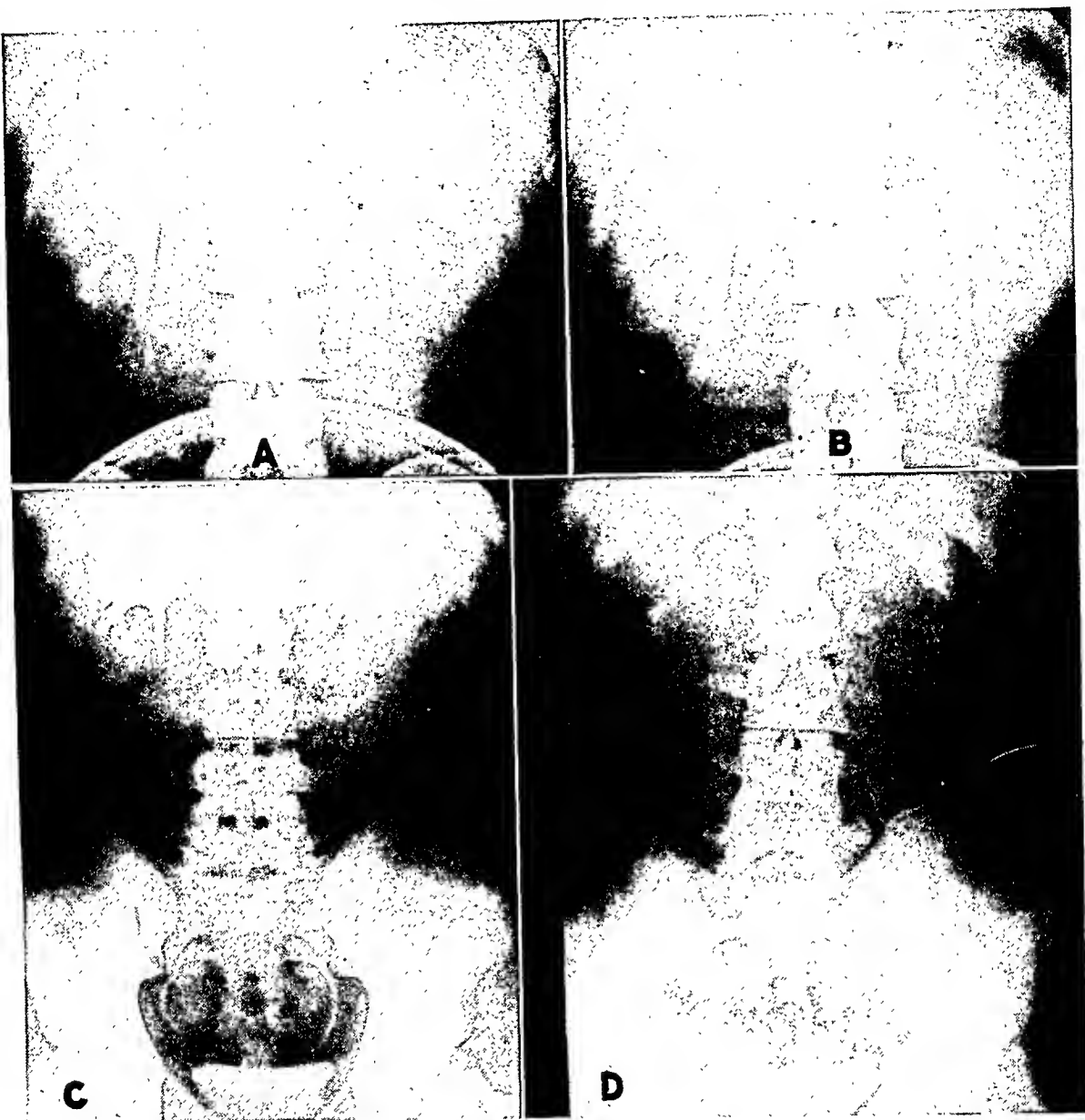


Fig. 61. A and B. Pair of stereoscopic films of the upper half of the urinary tract made approximately twelve minutes after the intravenous injection of diodrast and approximately seven minutes after application of pressure above the symphysis, a child's small football being employed to obtain satisfactory compression. As can be seen, the ureters are satisfactorily obstructed and the upper half of the tract is well visualized. No abnormalities are present. C. Urinary tract immediately following release of pressure above the symphysis. The lower portions of the tract, including the bladder, are most satisfactorily shown, as is usually the case in this film. D. Film made with patient upright, a routine exposure unless contraindicated. The pelvis and ureters are seen to have emptied satisfactorily, and the kidneys are in essentially their normal positions.

These exposures and those in Fig. 60 are the ones made in intravenous urography unless others are indicated.

is made for an exposure of the entire urinary tract on a 14 × 17-in. film. The pressure is released and the exposure is then made. The distal parts of the ureters are usually well demonstrated on this film. At this time the first film made can be examined, and this will determine the subse-

quent procedure. If normal excretion is taking place, we next make a film of the entire tract with the patient upright, in order to determine whether or not abnormal movement of the kidneys is present and whether or not the pelvis and ureters empty satisfactorily. The examination is



Fig. 62. Case 33: Ureteral calculus. A. Exposure made fifteen minutes after intravenous injection of diodrast, showing normal excretion to be taking place from the left side of the tract. The right kidney shadow is very dense, and only a suggestion of opaque material in dilated minor calices can be seen. Had the examination not been continued for a relatively long period, the examiner might well have assumed that the right kidney was not functioning. B. Film made two hours after the beginning of the examination, showing complete drainage to have taken place in the left side of the tract. The entire right side is now demonstrated, showing noticeable dilatation of the ureter and minor calices, with questionable slight dilatation of the kidney pelvis.

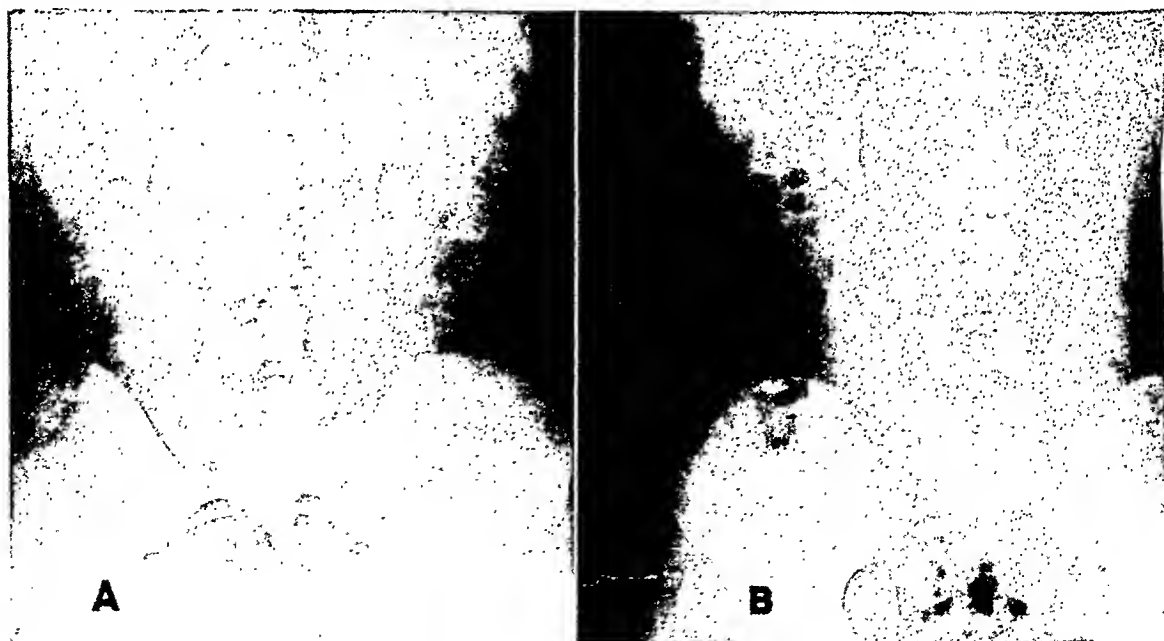


Fig. 63. Case 34. Carcinoma of the kidney. A. Findings during intravenous urography. The structures on the left are normal. The inferior calix on the right is deformed, a curved filling defect being present, suggesting pressure from a spherical mass of some type, thought to be a primary tumor of the kidney. B. Film made during retrograde examination. These two illustrations form a satisfactory basis for comparison of the two methods of examination.

then terminated. The routine exposures used in a normal case are shown in Figures 60 and 61.

If, on the other hand, normal excretion is not taking place, we continue the examination, making exposures at the intervals indicated by the findings in subsequent films. If excretion is delayed or apparently absent, the examination may be extended over a period of two hours, and one is frequently rewarded by satisfactory visualization in a kidney that would have been considered non-functioning had the examination been terminated earlier, particularly within the first forty-five minutes. When a stone is suspected low in the ureter, stereoscopic exposures of the lower urinary tract are made on 8 × 10-in. films, using a transverse shift. The history and findings in such a case follow:

CASE 33: A 23-year-old private, first class, had compound fractures of the tibia and fibula resulting from a gunshot wound suffered in the South Pacific in December 1942. While under treatment here, symptoms developed in the right ureter suggestive of a stone. Our intravenous examination showed dilatation of the pelvis, calices, and ureter on the right, together with a small shadow near the junction of the ureter with the bladder that had the appearance of a stone. The stone passed spontaneously and the pain subsided. Our findings are shown in Figure 62.

We test all patients for sensitivity to diodrast, placing a drop of this material in the conjunctival sac, as described by Archer, of the University of Virginia School of Medicine. Just what value this test may have is not known with certainty. We can only say that we refuse to do intravenous examinations in patients exhibiting a markedly positive reaction, of whom there have been relatively few. We have had no reactions of any consequence in the patients examined. Whether or not those with positive tests would have had reactions cannot be said. It is our opinion, however, that it is safer to make these few examinations by other methods than to take any chance.

Retrograde examinations of the urinary tract are done in the department of urology but under our direct supervision.



Fig. 64. Case 34: Photograph and photomicrograph of tubular adenocarcinoma of lower pole of kidney, invading the calix. The photomicrograph shows the tendency to reproduction of convoluted tubules.

Tumors of the kidney have been rare. An interesting one is shown in Figure 63, the history being as follows:

CASE 34: A 29-year-old private, first class, was transferred to our hospital with a diagnosis of hematuria of undetermined origin. He had been well until Nov. 22, 1943, when gross hematuria occurred. This persisted for five days and was accompanied by some discomfort in the right upper quadrant. An excretory urogram was made on Dec. 7, 1943, showing a deformity of the middle and lower calices of the right kidney considered to be due either to a malignant tumor or cyst. Because of history



Fig. 65. Characteristic findings in a case of horseshoe kidney. An intravenous type of examination (A) was first done. It is obvious that a horseshoe kidney is present, but the characteristic changes are much more satisfactorily demonstrated by the retrograde method (B). An area of decreased density can be seen in the pelvis of the right kidney due to the presence of a non-opaque stone.

of gross hematuria, the former diagnosis was considered the most likely. Right nephrectomy was done, and a soft, well circumscribed tumor was found in the area where deformity was previously observed. There was no evidence of enlargement of the adjacent lymph nodes. Microscopic examination showed the lesion to be an infiltrating tubular carcinoma.

A horseshoe kidney is shown in Figure 65.

We have seen a number of testicular tumors, with disturbance of the urinary tract due to retroperitoneal metastases. The importance of excretory urography in determining the activity of testicular tumor implants in the preaortic and pararenal lymph nodes has been stressed by Chamberlin and Jamison (3). A characteristic appearance may be produced by this disease, the most frequent finding being lateral, or rarely downward, dislocation of the kidney with or without an obstructive uropathy. Although it is possible that such displacement may occur in other types of retroperitoneal tumor, it is rare in our experience. In those cases where intravenous urography is negative, this serves as a control to evaluate the patient's condition at a later date. It should be borne in mind that metastases from a left

testicular tumor will usually involve the left renal hilum, while metastases from the right testis, due to the peculiarities of the lymphatic pathways, may involve either side, not infrequently being most prominent on the left. Even in the absence of a demonstrable testicular tumor this roentgen picture should bring to mind the rare possibility of an occult testicular neoplasm with large retroperitoneal implants. The relief of an obstructive uropathy or the return of function in a previously non-functioning kidney is an encouraging sign and may be of considerable prognostic significance. An illustrative case history follows.

CASE 35: A 36-year-old corporal was inducted in July 1942. He gave a history of having been operated upon for a right undescended testicle in 1924. During the winter of 1942 he began to suffer from night sweats and low back pain. In April he noticed he was losing weight, and what was thought to be a hydrocele developed following an injury in the course of exercise. Fifteen days later a large mass was noted in the right side of the abdomen. The abdomen was distended and there was a large, irregular nodular mass in the right upper quadrant, apparently obstructing the vena cava. The right testicle was greatly enlarged, and a firm, nodular mass was present. An intravenous examination of the urinary tract revealed a non-functioning kidney



Fig. 66. Case 35. Malignant tumor of the testicle with obvious extensive metastases in the abdominal area. In A the left psoas shadow is seen to be largely obliterated and the right psoas shadow to be slightly hazy. The lower arrows demonstrate the defect in the posterior arch of the fourth lumbar vertebra due to a metastatic lesion. B. Findings on intravenous urography. The right kidney was apparently non-functioning, for no suggestion of opaque material could be found on the right side of the tract during the two-hour period following the injection. The excretion on the left was satisfactory, but the left kidney is seen to be displaced lateralward, presumably by retroperitoneal metastases in the kidney area. C. Retrograde pyelogram on the right, nine days after the intravenous examination was done. The patient was receiving radiation therapy during the interval between examinations and had already shown considerable improvement. This illustration shows only moderate dilatation of the kidney pelvis and minor calices. The kidney is displaced lateralward and a faint shadow can be seen, indicated by arrows, apparently due to metastases. D. Findings on intravenous examination approximately one month after the patient was first seen. During the interval he received radiation therapy and showed marked improvement. The function of the right kidney has returned and the dilatation shown previously at the retrograde examination has largely disappeared. The displacement of the kidney is considerably less than in earlier examinations.

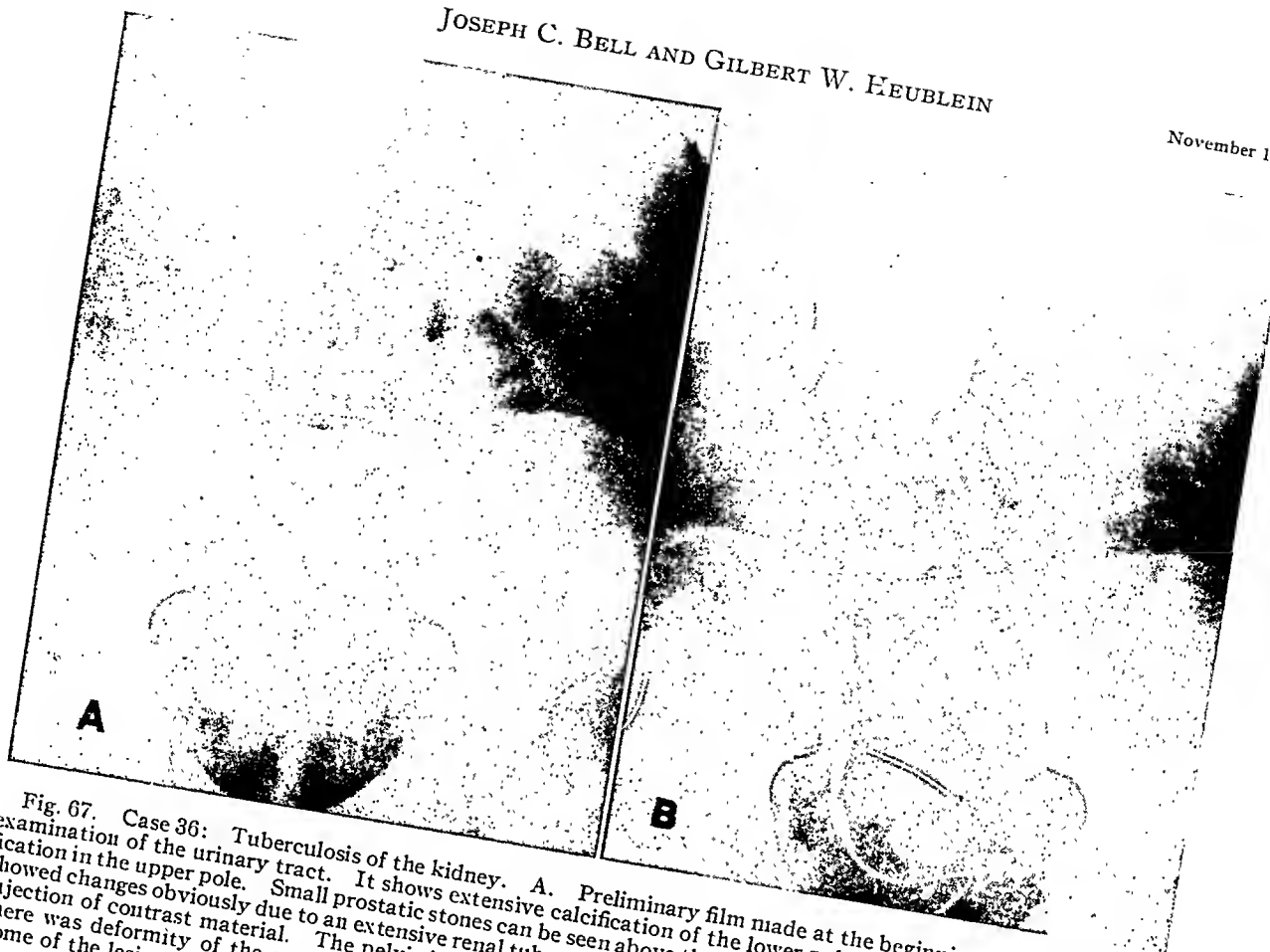


Fig. 67. Case 36: Tuberculosis of the kidney. A. Preliminary film made at the beginning of an intravenous examination of the urinary tract. It shows extensive calcification of the lower pole of the kidney and some calcification in the upper pole. Small prostatic stones can be seen above the symphysis. The intravenous examination showed changes obviously due to an extensive renal tuberculosis on the right. B. Film made following retrograde injection of contrast material. The pelvis is greatly deformed. The middle and inferior calices did not fill, and there was deformity of the superior calix. This kidney was removed later and showed extensive tuberculosis. Some of the lesions were active; others were largely healed.

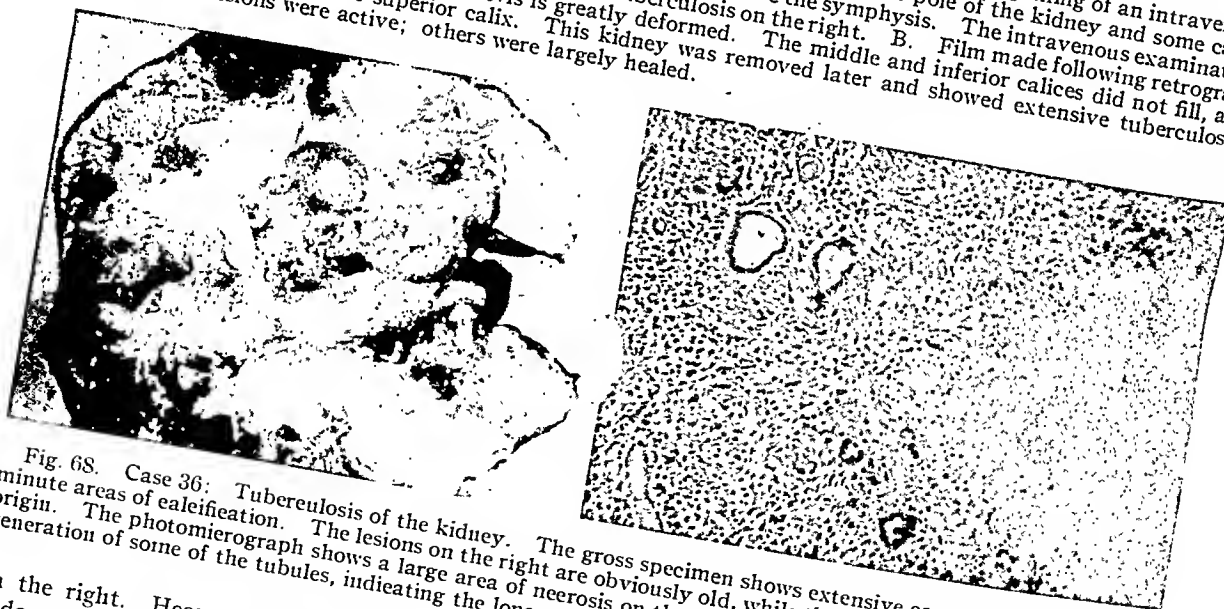


Fig. 68. Case 36: Tuberculosis of the kidney. The gross specimen shows extensive caseation with numerous minute areas of calcification. The lesions on the right are obviously old, while those on the left are of more recent origin. The photomicrograph shows a large area of necrosis on the right. On the left there is an attempt at regeneration of some of the tubules, indicating the long-standing nature of the disease.

on the right. Heavy radiation was given to the abdomen, the testicles, and the left supraclavicular area, where a firm palpable mass was found. The masses in the abdomen, supraclavicular area, and testicle regressed rapidly. A plaque-like tumor developed above the left side of the diaphragm, which also disappeared promptly after irradiation. The

right testicle was removed, and the microscopic examination showed only fibrous tissue remaining. It was obvious, however, that the primary lesion was a malignant tumor. The patient did well, gained weight, and in January 1944 was discharged to the Veterans' Facility for further follow-up and care. Films of the urinary tract made before and



Fig. 69. Case 37: Large defect in the ulna resulting from a gunshot wound. The illustration on the right shows the repair of the defect by onlay grafts and bone chips.

after irradiation, demonstrating return of function in the right kidney, are shown in Figure 66.

The following is an example of tuberculosis of the kidney.

CASE 36: A 44-year-old captain was admitted to Percy Jones General Hospital Dec. 17, 1943, complaining of pain on urination, urgency, frequency, and terminal hematuria for a period of ten days. He denied having any previous urinary symptoms. Examination showed irregular calcification in the right renal area together with multiple stones in the prostatic region. Tubercle bacilli were found in the catheterized specimen from the right ureter and a guinea-pig inoculation was positive. An intravenous examination showed evidence of destruction in the region of the lower pole of the right kidney. The function of the kidney, however, was not seriously impaired. Nephrectomy was done Feb. 5, 1944. The x-ray findings are shown in Figure 67. Examination of the removed kidney showed areas in which the infection was active and others where healing with fibrosis and calcification had taken place.

FOREIGN BODIES, BONE DEFECTS, AND FRACTURES

Metallic foreign bodies are encountered frequently in our battle casualties. They include shrapnel fragments from exploded land mines and tiny fragments said to be from explosive bullets. These have been seen in all parts of the body: in the

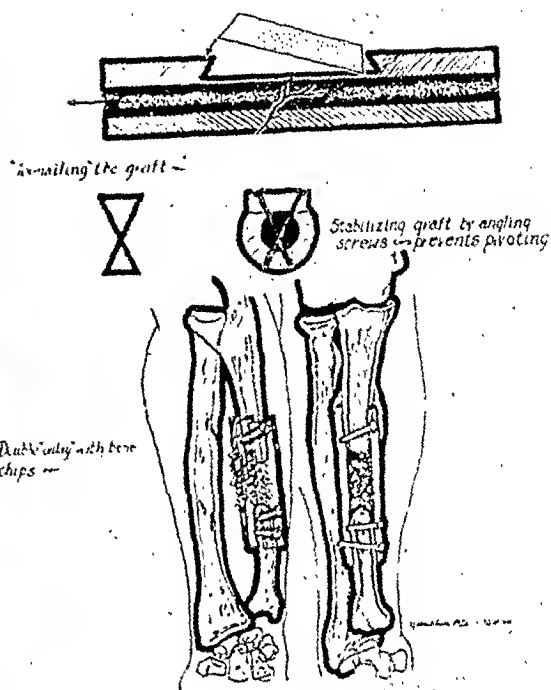


Fig. 70. Case 37: Drawings by Major Heublein from x-ray films, showing repair of defect in the ulna by onlay grafts and bone chips.



Fig. 71. Defect in the femur resulting from a gunshot wound repaired by onlay grafts.

skin and subcutaneous tissues, imbedded in the skull, in the brain, in the chest, in the extremities, and in many other places. Many foreign bodies may be present in a single patient, and these are often widely distributed. No attempt is made to re-

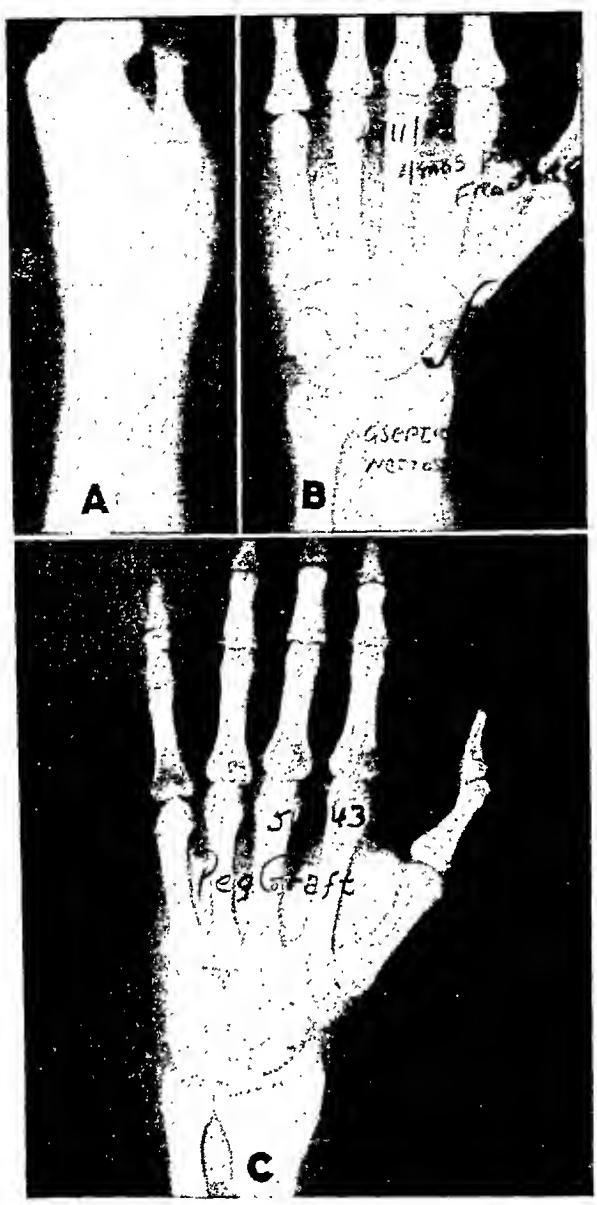


Fig. 72. Case 38: A and B. Ununited fracture of the scaphoid four months after injury, with evidence of aseptic necrosis of the proximal fragment. B. Use of a peg graft in the repair of the ununited fracture.

move them unless they are causing symptoms, which in most instances they apparently are not. Defects in soft tissues and in the bones adjacent to the foreign bodies are frequently observed, due to loss of bone and soft tissue substance resulting from the passage of the fragments of metal through these structures.

The following case histories and figures illustrate some operations employed for correction of bone defects and for non-

union of fractures. Internal fixation of fractures is used only where more conservative measures have failed.

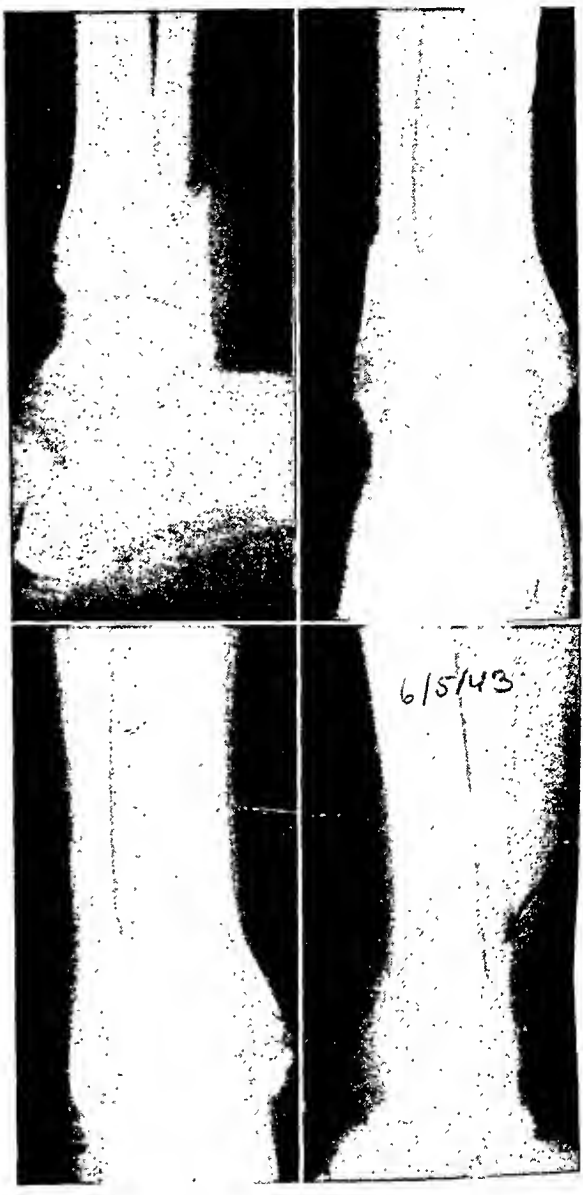


Fig. 73. Ununited fracture of the distal end of the fibula, with repair by an inlay autogenous graft, as shown in the lower views.

CASE 37: A 23-year-old sergeant suffered a fracture of the ulna as the result of a gunshot wound received in the South Pacific in January 1943. A large segment of the middle third of the bone was shot away. He was treated at a station hospital and later evacuated to the United States and sent to our hospital. The defect was repaired by onlay grafts and bone chips as is indicated in Figures 69 and 70.

CASE 38: A 22-year-old corporal, while in the

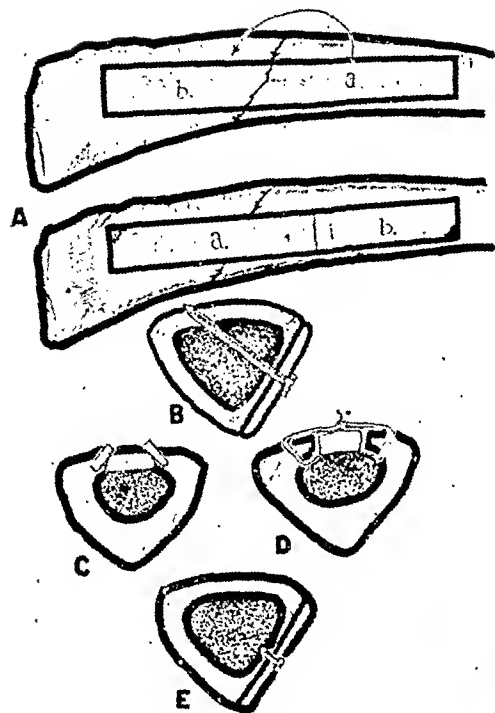


Fig. 74. Drawings by Major Heublein showing various types of grafts, slightly modified from Campbell. A. Sliding Albee inlay graft. B. Onlay graft, correct. C and D. Inlay grafts held by pegs (C) and by chromic (D). E. Onlay graft, incorrect.

South Pacific, received a fracture of the carpal scaphoid on Jan. 7, 1943. An examination at our hospital done April 12, 1943, showed some aseptic necrosis of the proximal fragment and cystic changes along the fracture line. It was evident that bony union was not taking place and a peg graft was inserted April 27, as is shown in Figure 72.

CASE 39: A 31-year-old private was injured in an automobile accident in this country July 13, 1943. He sustained an extensive comminuted fracture of the proximal third of the right femur. Our examination showed marked separation of the major fragments. Traction did not result in satisfactory reduction. At operation soft tissue was found to be interposed between the fragments. Reduction was done and the fragments were fixed with metal plates and screws as shown in Figure 75. Satisfactory bony repair took place, and the patient is to be returned to duty.

COMMENT

The radiologist in an Army general hospital is afforded an unusual opportunity to see a wide variety of cases and to follow them in a way that is frequently not possible even in many of the best private institutions in this country. This is due to

the fact that patients are discharged only after they have reached maximum hospital improvement, which not infrequently may require treatment over a period of many months.

In the Percy Jones General Hospital we have an adequately equipped department. In no instance has any tendency been shown to curtail the completeness of an indicated examination or to limit the number of necessary re-examinations.



Fig. 75. Case 39: A. Extensive comminuted fracture of the femur with displacement of fragments. Satisfactory reduction could not be secured by conservative methods. An open operation was done, satisfactory reduction was obtained, and the fragments were fixed by multiple plates, as shown in B and C. These illustrations show the fixation screws passing well through the cortices.

The specialty of radiology is firmly established in Army general hospitals. That this is true is in a large measure due to the work of our pioneers in radiology, one of the greatest being the physician to whom we here pay tribute, Preston Manasseh Hickey.

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Intra-Ocular Calcium Shadows; Choroid Ossification¹

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THE ROENTGEN demonstration of calcification in the eyeball is rare. More frequently intra-ocular calcification is suspected on clinical examination and proved by subsequent dissection of the enucleated eye. Rollet (20) in 1913 was the first to report the discovery of choroid ossification by radiography. Subsequent observations have been added by Appelmans (1), Cuénod and Nataf (5) del Duca (6), Dunn (7), Guarnido (8), Hartmann (9), Huber and Picena (12), Issatchenko and Filatoff (14), Kaufmann (15), Perez Ara (17), Rocha (19), Salvador Junior (21), Satanowsky (23), de Souza Queiroz (26), Velter (28), Worms (29), and Wegener-Thomsen (30). While the majority of writers have contributed single observations, Worms, Rateau, and Leroux-Robert (29), Imai (13), Hartmann (9), Huber and Picena (12), de Souza Queiroz (26), Bane (2), and del Duca (6) were each able to report on several personal cases. Huber and Picena (12) were the last to contribute a comprehensive clinical and radiological study. Most observers agree as to the roentgen findings and the often histologically proved diagnosis of choroid ossification.

Twining and Shanks (27) distinguish four groups of intra-ocular calcium shadows: (1) calcification of the lens, (2) ossification of the vitreous, (3) calcified atheroma of the carotid and ophthalmic arteries, and (4) a shrunken calcified globe. Arteriosclerotic shadows are usually extra-bulbar within the orbit or within the optic canal posteriorly to the globe. Shadows produced by intra-ocular calcium can be readily distinguished from those due to metallic foreign bodies, to siderotic impregnation following incomplete removal of metallic dust, and to residual thorotrast following orbitography.

According to Duke-Elder (25), bony cataract is fairly common in the late stages of a complicated cataract. This is well known to ophthalmologists, and numerous clinical and experimental observations have established the potential bone metaplasia of the choroid. Gluge in 1843, and later Kirk, Spree and Wittich, described the pathology of osseous cataract, and Virchow, Knapp, *et al.* have shown that the internal aspect of the choroid is the site of origin of this metaplasia. Virchow found that the ossification was usually associated with globular phthisis and that this was the result of a long-standing suppurative lesion following a severe injury of the eye. Samuels (22) and Zwiauer (31) have shown that the ossification is mainly confined to the choroid, with predilection for the posterior quadrant, while the iris and ciliary body seldom ossify. Samuels distinguishes three types: plates of solid bone, thick shells, and spicules of bone. Böck (4), Birich (3), Herrenschwand (10), Imai (13), and Schilling (24) have proved that ossification is the result of a degeneration of the lens fibers, no matter what the etiology of the cataract may have been. Sclerosis and necrosis occur first and in many cases degenerative changes follow, with calcium impregnation. Bane (2) believes that bone is formed from connective tissue through metaplasia of an organized exudate. Long-standing severe uveitis and subsequent disorganization of the eye favor deposits of bony tissue on the inner side of the choroid, starting usually near the entrance of the optic nerve and extending toward the ciliary body, often forming an almost complete osseous cup. This degeneration into ossification precludes a serious, long-standing inflammatory condition, which in many instances was primarily caused by a direct penetrating injury or by repeated, sometimes metastatic infection leading to cataract.

¹ From the Departments of Radiology of the New York Hospital and the New York Eye and Ear Infirmary. Accepted for publication in February 1944.

A clinical diagnosis of ossification of the choroid may often be suggested by the physical examination. Blindness, cataract, and the presence of a hard intra-ocular mass in an atrophic bulb are strongly suggestive. Sometimes the differential diagnosis may point to glaucoma, sympathetic panophthalmia, or tumor rather than to choroid ossification.

The diagnosis is definitely established

into the anterior global hemisphere. With a luxated lens, the shadow shifts accordingly in an anterior or postero-inferior direction. Sometimes the shadow assumes the shape of a ring a few millimeters in thickness, with or without an isolated area of calcium density in the center or in a peripheral segment. The shape depends largely on the roentgenographic projection. In a few instances metallic foreign bodies

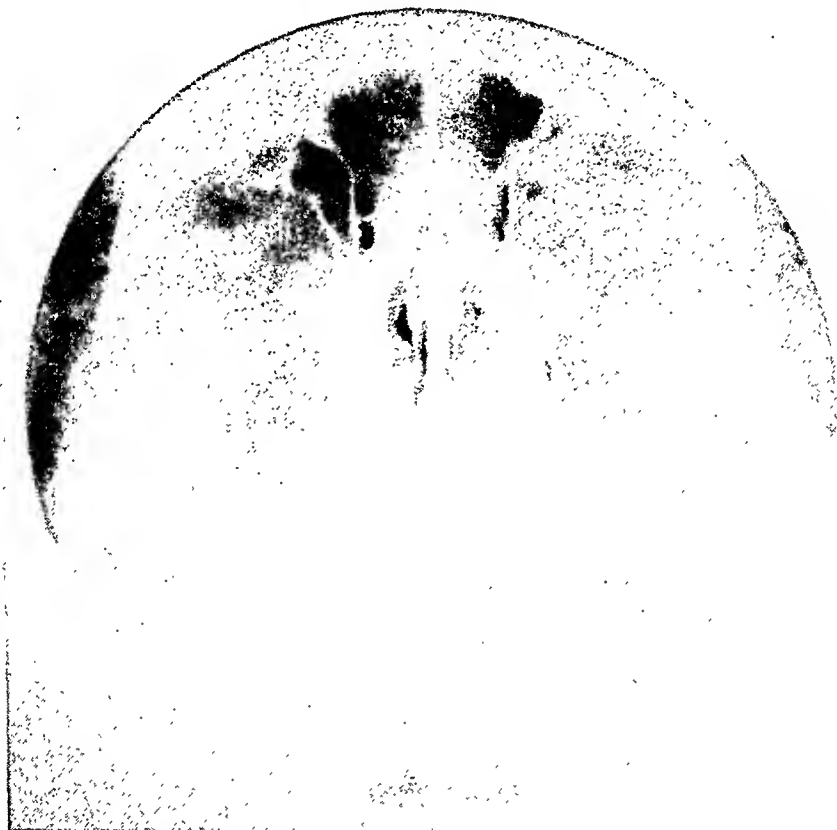


Fig. 1. Case 1: Annular calcium shadows in both eyes.

by the roentgen finding of rather typical shadows of bony density in the globe. These findings as reported in the literature and as observed on our own material present striking similarities. Usually there is a shrunken eyeball, a large central area of which is occupied by a well delineated, fairly regular, ovoid, circular or semicircular, dense, although not strictly homogeneous, calcium shadow. This shadow occupies the region of the lens and extends more frequently into the posterior than

have been observed near the calcium shadow. The roentgenographic image corresponds to the anatomic finding of shell-like ossification of the choroid and of the lens. There may be additional small calcium densities scattered throughout the eyeball according to the extent of the choroid and invasion of the cornea. All observers agree on the bony character of the lesions, and roentgen observations of calcium shadows of bone-like structures have been repeatedly reported. Opaque or semiopaque for-



Fig. 2. Case 2: Shell-like calcification in right eye, with eccentric nuclear calcification.

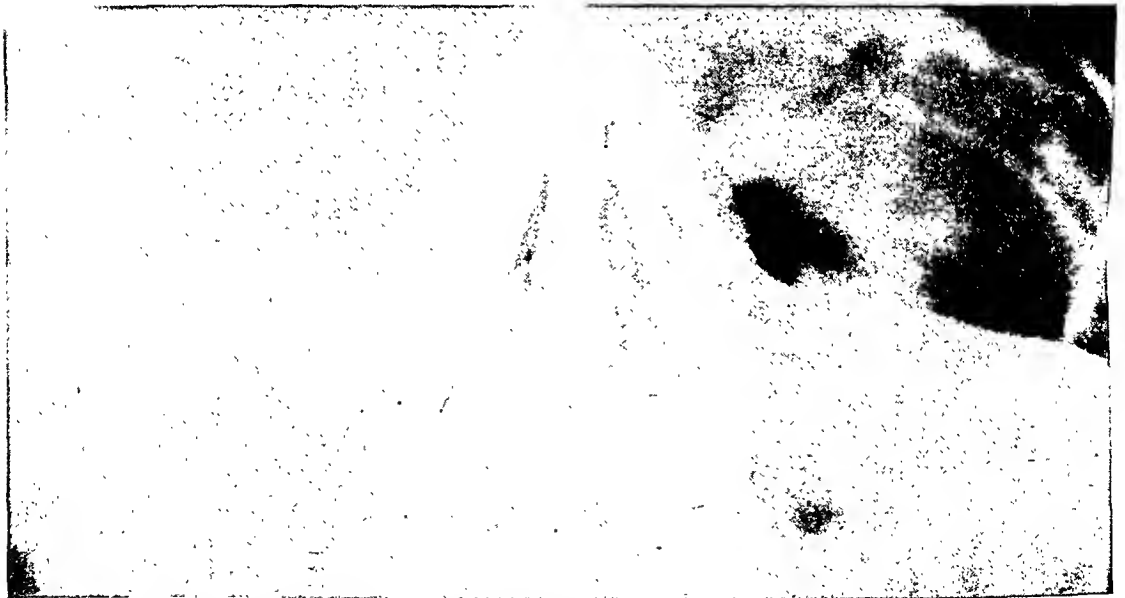


Fig. 3. Case 3: Thin shell-like calcification with nuclear calcification in right eye.

eign bodies, vascular calcifications, phleboliths, orbital angioma, osteoma, and endocranial calcifications offer no difficulties in differential diagnosis. Pfeiffer (18) has reported calcium deposits in congenital

retinoblastoma in children. The preference for the infantile age group and the somewhat eccentric granular distribution of the calcium shadows in the eye help to distinguish these tumors from heteroplastic

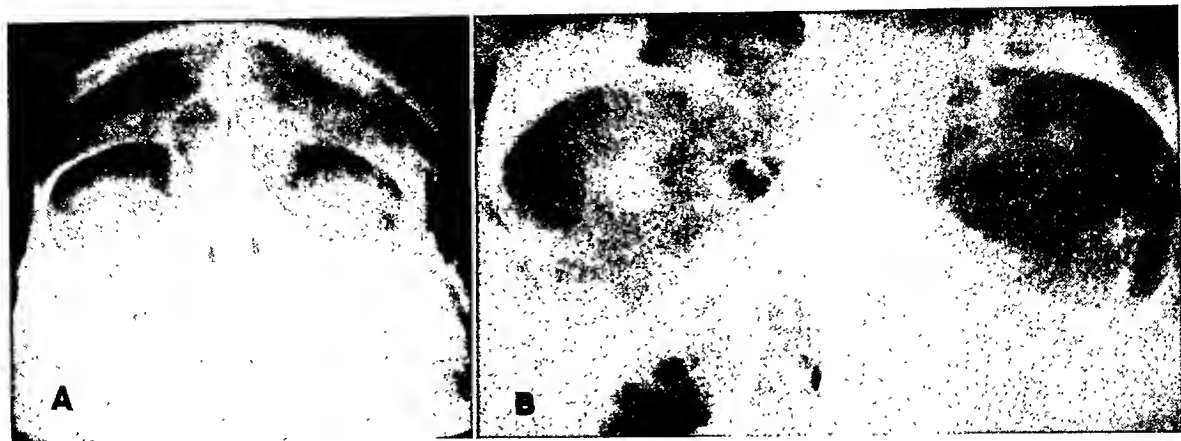


Fig. 4. Case 4: A. Calcification of lens and metallic foreign body in left eye. B. Same case six years later.

bone formation in the choroid. Few cases of the latter condition have been reported in children; the majority occur in and beyond middle age.

The radiographic picture varies according to technical factors, as in any other structure. It depends largely on the degree and extent of the calcium density and on adequate roentgen-physical conditions of the surrounding orbital structures. The bones of the orbit are apt to cause a blurring of the calcified mass to such a degree that the lesion is often overlooked or only faintly seen. Motion of the eye may completely erase a thin calcium plaque. This explains why, in spite of positive clinical and anatomical findings, reports of successful radiographic demonstration have been scarce. On the other hand, intra-ocular ossification has been observed on routine radiography as an unsuspected and incidental finding.

Three methods lend themselves best to the demonstration of intra-ocular calcium densities. The clearest view is offered by the postero-anterior projection of the orbit, by an additional lateral view as it is used for foreign body localization, and by the "bone-free" technic. The latter eliminates most of the surrounding structures and permits a clear view of the anterior two-thirds of the globe. We have used all methods and we have obtained satisfactory radiographic visualization in all cases. The orbit should be investigated in any radiographic study of the facial bones,

skull, and sinuses. Some experience is necessary in regard to the confusing shadows of bony structures, sutures, and differences of the soft tissues of the globe and the fat capsule. Stereoscopic and planigraphic views and orbitography with air may still improve the roentgen demonstration.

CASE 1: A colored male of 21 years gave a history of cerebral and spinal meningitis at the age of thirteen. Chorioretinitis developed, followed by blindness of both eyes. Tuberculin tests and Wassermann reaction were negative. The right eye showed a corneal scar and the left scarring of both iris and cornea. There were no further neurological signs or symptoms.

Final Clinical Diagnosis (Dr. Samuels): Complete bilateral blindness probably due to chorioretinitis resulting from cerebrospinal meningitis.

Roentgenography showed in each orbit, slightly lateral to the center, an annular calcium shadow with radiolucent center (Fig. 1). The outer margins were irregular and there was a calcium plaque on the left, extending from the ring shadow in a lateral and downward direction.

CASE 2: A woman 49 years of age had fallen as a child and shortly afterwards lost the sight of the right eye except for some light perception. At the age of eighteen an operation was done on the right eye to straighten it. The patient did fairly well following this but in later years experienced pain in both eyes. Roentgen examination revealed a calcium shadow in the region of the right lens (Fig. 2). Histologic study of the enucleated eye led to a diagnosis of choroid ossification.

CASE 3: A middle-aged patient gave a history of a foreign-body injury to the right eye in childhood, with subsequent loss of vision. Roentgen examination revealed a spherical calcium shadow 1.5 cm. in diameter, irregularly calcified and occupying a large part of the eye. There was a complete outer shell and a central amorphous calcium deposit (Fig. 3).

CASE 4: A woman of 42 years came in 1937 and in 1943 for routine examination of the paranasal sinuses. No complaints referable to the eyes were recorded and no history was obtained. On both examinations a complete calcification of the lens and a metallic foreign body were seen in the left eye (Fig. 4 and Fig. 5D).

CASE 5: This patient was 55 years of age. A piece

case calcification of the capsule of the lens of the left eye (Fig. 5B) with a shrunken globe, and in the other case irregular plaque-like calcification of the capsule of the right eye (Fig. 5A). There were no foreign-body shadows present.

Several other cases have been seen in the past ten years but have not been recorded.

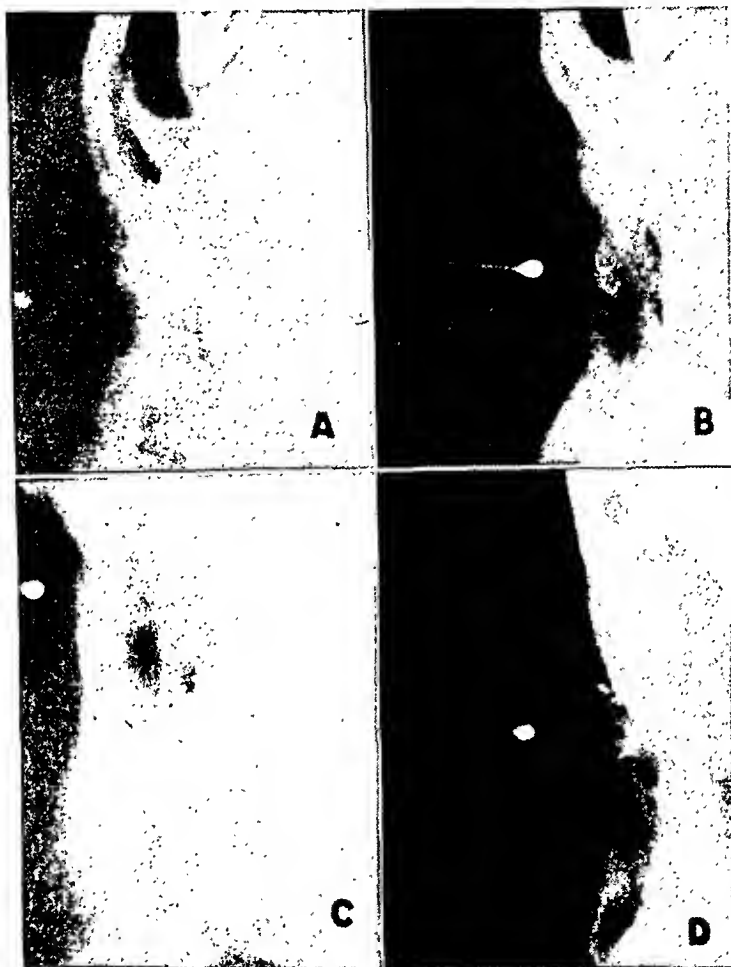


Fig. 5. Choroid calcification as seen in four different cases. Lateral views for foreign body localization.

of steel had pierced the right eye almost thirty years before. There had been pain and redness of the eye for several months following the injury. The vision diminished gradually, and the eye became blind. The patient came for examination of the left eye. On this occasion the right eye presented the appearance of a chronic glaucoma and the tension to the fingers was maximum normal. Roentgen examination revealed a shell-like calcium shadow in the right orbit almost completely occupying a shrunken globe. There was no foreign-body shadow (Fig. 5C).

CASES 6 and 7: Two patients gave a history of foreign-body injuries many years prior to the present examination. Roentgenograms revealed in one

The 7 cases reported involved in 1 instance both eyes, in 4 the right, and in 2 the left eye. Most of our patients gave a history of a foreign-body injury to the eye with subsequent signs of infection, deformity of the globe, and loss of sight. Pains persisted only for some time following the injury or recurred after a painless interval of several years. The first painful episode probably coincided with the acute and sub-acute infectious stage which forms the basis of the metaplastic choroid involve-

ment. The patients became accustomed to the anatomical lesion, and in only a few instances was enucleation of the eye performed. The majority of our patients were middle-aged, and accidental disturbances of the remaining eye or recurrence of pain in the previously damaged eye brought the lesion to medical attention. In several instances no complaints were recorded and the lesion was an incidental finding on sinus radiography.

SUMMARY

1. Calcium shadows in the region of the lens have been repeatedly observed by ophthalmologists. Roentgenologic reports are scarce.
2. The authors have observed 7 cases of intra-ocular calcification and report their clinical, anatomic, and roentgen findings.
3. The anatomical lesion is a more or less extensive choroid ossification. The bony character of the lesion can often be disclosed radiographically.
4. The lesions can readily be seen on conventional roentgenograms of the orbit. Lateral foreign body localization exposures and "bone-free" technic improve the roentgenographic demonstration of intra-ocular ossification and determine the size, shape, position, and essential bony character of these shadows.

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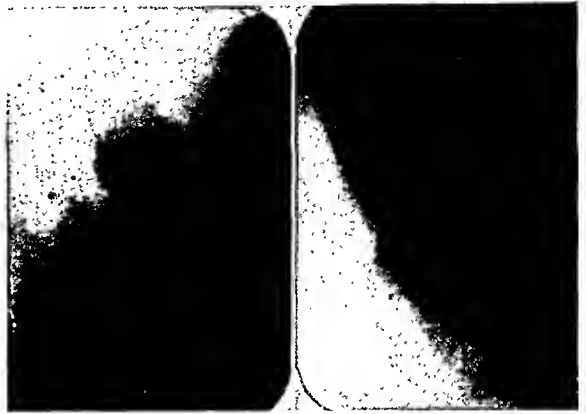


Fig. 6. Calcified lens (two cases) demonstrated by bone-free technic.

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The Value of the Axial Projection of the Petrous Bone in the Diagnosis of Chronic Mastoiditis and Cholesteatoma¹

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IN CHRONIC mastoiditis the pathological process is most frequently established within or near the mastoid antrum and tympanic cavity. In such cases, therefore, good roentgenographic demonstration of these structures is of paramount importance, but it is rarely if ever obtained by means of the routine projections.

cerning the mastoid antrum. In the author's experience, however, these do not display the wealth of detail and convincing clarity of the projection described some twenty-odd years ago by Ernst G. Mayer of Vienna. This view is technically difficult and intricate and the distortion of the temporal bone, with the exception of an-

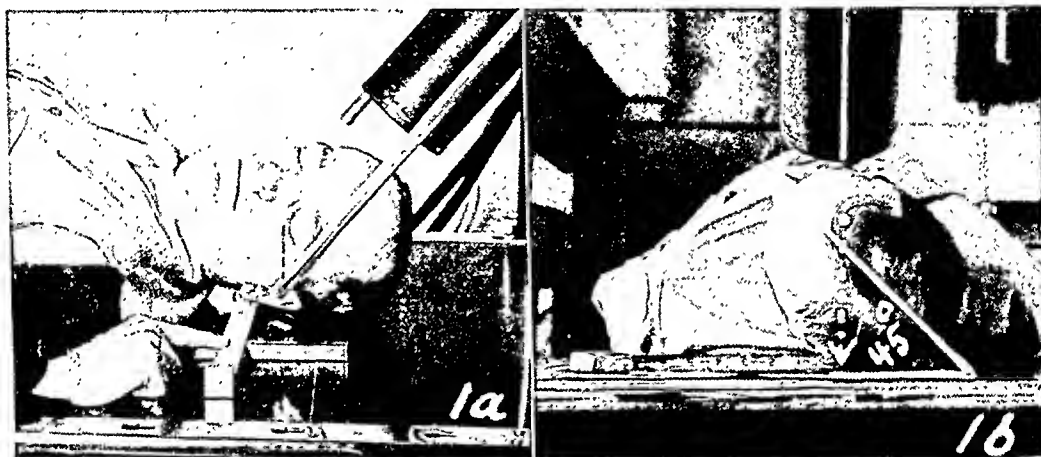


Fig. 1. Positioning to obtain axial projection of the petrous bone. Note the 45-degree caudal angulation of the x-ray tube, the direction of the central ray through the external auditory meatus, and the 45-degree lateral rotation of the patient's head. The technician's finger points to the yardstick for measuring the distance from the mastoid tip to the edge of the cassette. Use of this measured distance for exact centering to the mastoid tip is demonstrated in Figure 1b.

Law's and Schueller's lateral projections portray the extent and condition of the pneumatized area, the mastoid process, and the venous sinus. Stenvers' and Granger's projections allow visualization of the petrous apex, upper petrosal ridge, inner auditory meatus, and labyrinth. Taylor's base view demonstrates the petrous apex and inner auditory meatus from a different angle and shows their relation to the sphenoidal sinuses. None of these views, however, demonstrates the mastoid antrum.

Recently, the cranially eccentric base views of Steward and Chamberlain-Towne have been recommended for problems con-

cerning the mastoid antrum, tympanic cavity, external auditory meatus and venous sinus, is considerable. Moreover, Mayer's instructions for placing the patient and arranging the tube and film cassette are difficult to follow.

These difficulties probably explain why his projection has not become popular in the United States despite its undeniable merits. The purpose of this publication is merely to describe the positioning of the patient and the arrangement of tube and cassette more in detail, to give Mayer's useful projection another fair discussion, and further to add support by representative illustrations.

The basic idea of Mayer's oddly distorted view of the mastoid area is to obtain

¹ Accepted for publication in March 1944.

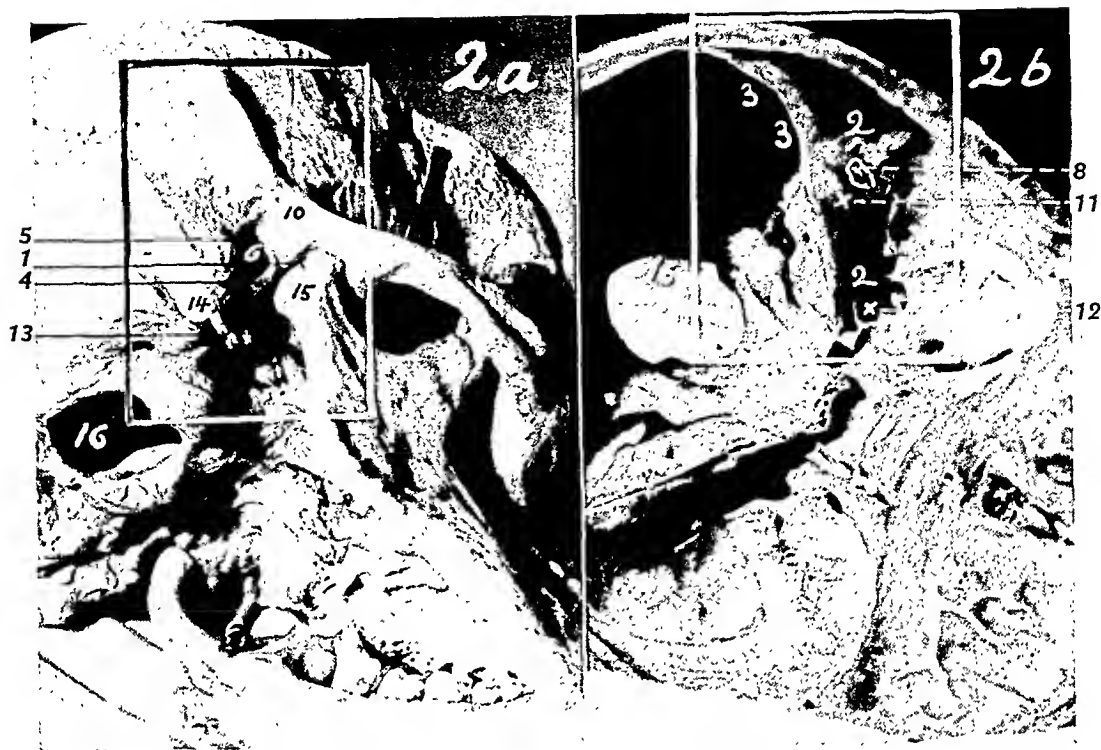


Fig. 2. External and internal views of the skull to demonstrate the unfamiliar anatomical features of the axial projection. To permit better comparison with the roentgenograms, the skull has been photographed upside down, thus compensating for the exaggerated downward projection of the petrous tip caused by the 45-degree caudal angulation of the tube. 1. Temporomandibular joint. 2. Petrous pyramid, vertically placed. 3. Groove of sigmoid sinus. 4. Anterior auditory canal wall. 5. Posterior canal wall. 6. External auditory meatus; in its depth the tympanic cavity is located. 8. Area of the tegmen antri. 10. Root of zygomatic arch. 11. Area of the labyrinth. 12. Carotid canal. 13. Styloid process. 14. Mastoid tip. 15. Head of mandible. 16. Foramen magnum.

a roentgenographic demonstration of the mastoid antrum, attic, tympanic cavity, and posterior auditory canal wall, particularly in conditions where sclerosis of the petrous bone has developed. In his projection the central ray strikes the temporal pyramid at an acute angle along its longitudinal axis (Fig. 1), resulting in a greatly distorted view of the petrous bone (Fig. 2). The antrum, attic, tympanic cavity, and posterior canal wall are, however, ideally visualized, undistorted, free from superimposed bone structures, presenting a surprising wealth of detail, "as if a curtain has been lifted from these structures."

TECHNIC

(Fig. 1a and b)

A. Positioning the Patient and the Film Cassette

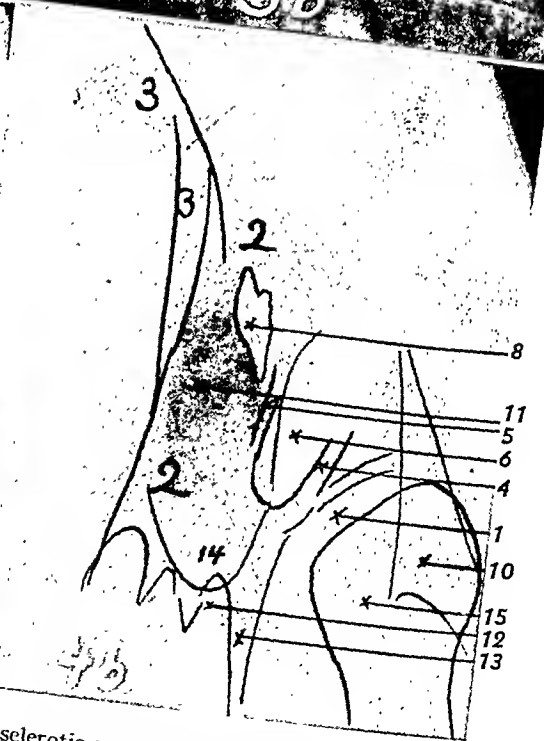
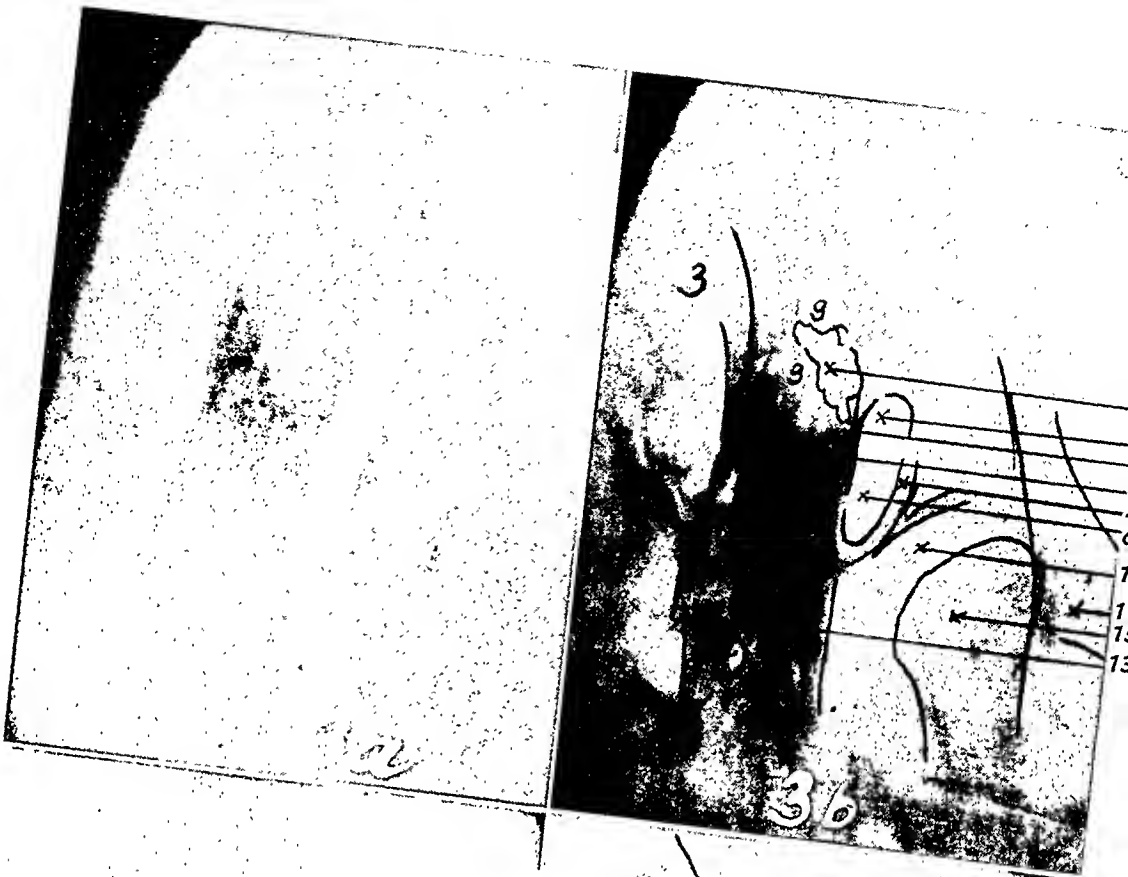
- (1) Assuming that the *left* mastoid is to be examined, place the patient in the supine position

with the chin depressed sufficiently so that the base line of the skull—connecting the infraorbital ridge with the osseous external auditory meatus—assumes a vertical position.

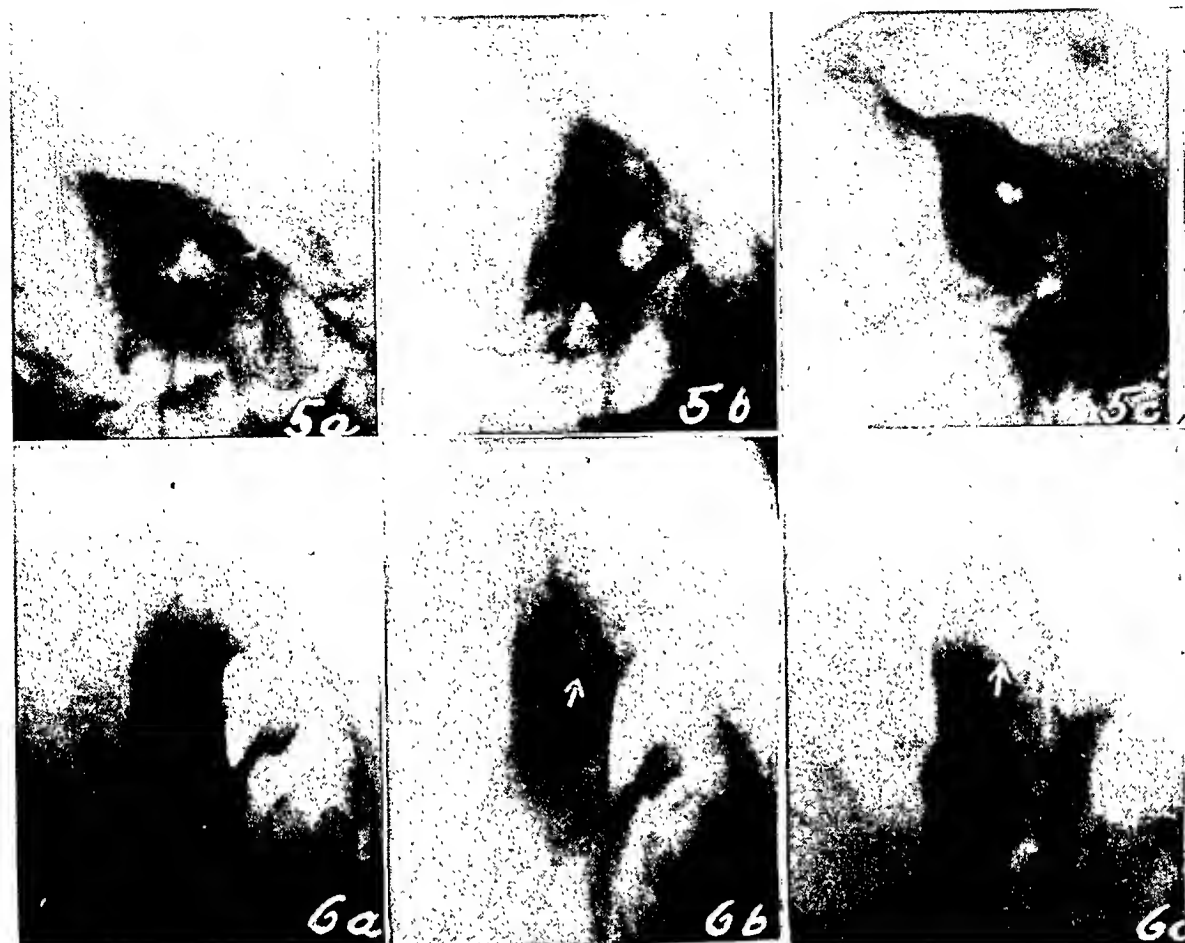
- (2) Place the film cassette, size 8 × 10 inches, lengthwise so that its upper edge is about one inch above the upper border of the auricles, its lower border below the left shoulder region, its left edge about 3 or 4 inches beyond the left lateral border of the skull. (The technician experienced in this work will improve the quality of the films by using a cassette 5 × 7 inches and elevating the upper and the left edge of the cassette.)
- (3) Rotate the patient's head for exactly 45 degrees laterally toward the left side, but avoid tilting in any direction. Fold the left auricle forward and keep in position by means of a soft paper ball.

B. Centering the Tube

- (4) Stand at the side being radiographed, tilt the tube for 45 degrees caudally, and direct the central ray through the external auditory meatus of the left ear.



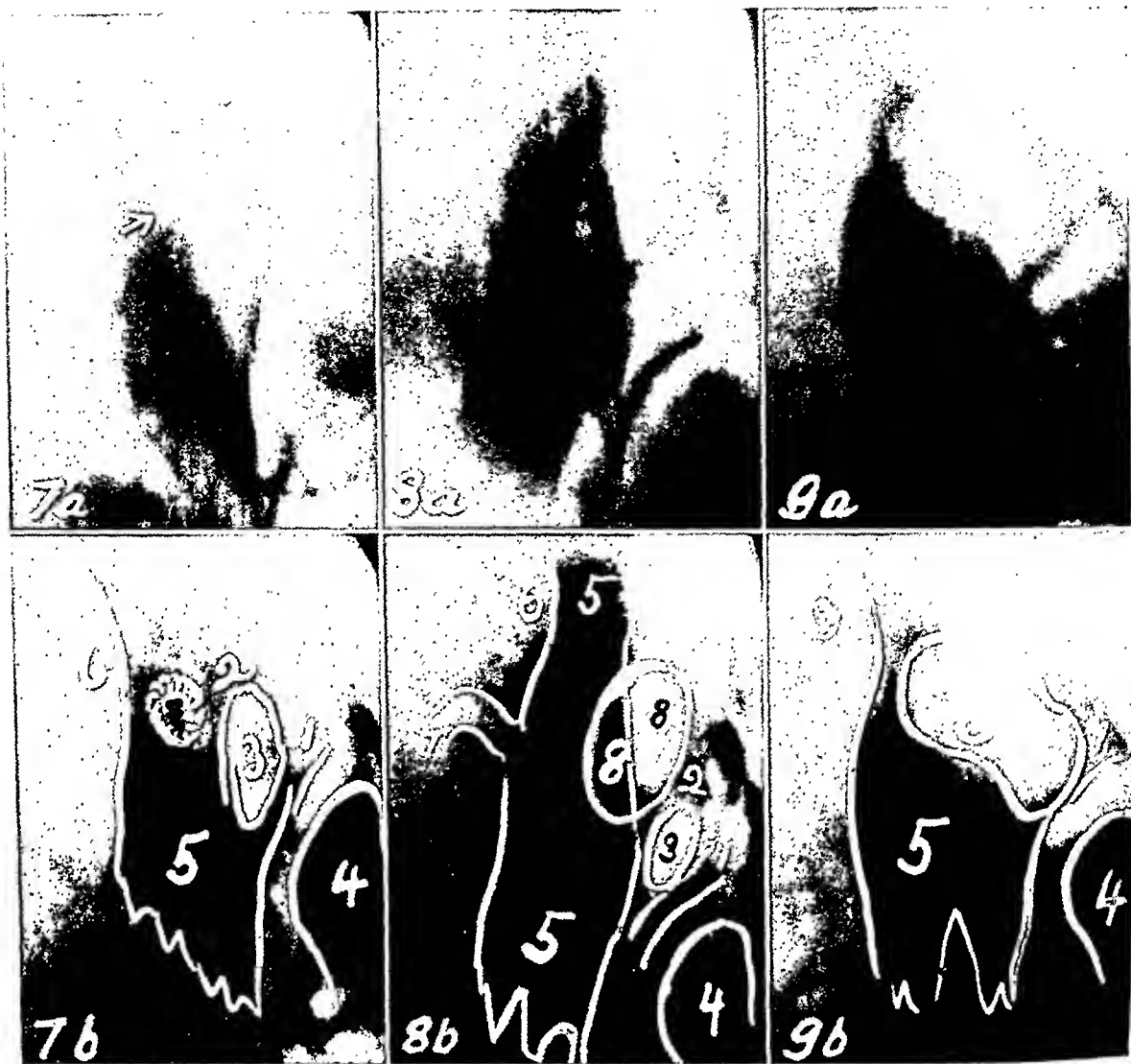
Figs. 3 and 4. Normal well pneumatized mastoid and sclerotic mastoid, respectively, both in axial projection. 1. Temporomandibular joint anteriorly. 2. Petrous pyramid, appearing as a broad vertical shadow band. 3. Venous sinus posteriorly. 4. Anterior canal wall. 5. Posterior canal wall. 6. Tympanic cavity and superimposed external auditory meatus. 7. Epitympanic recess (attic). 8. Antrum. 9. Periantral cells. 10. Root of zygomatic arch. 11. Area of the labyrinth. 12. Carotid canal. 13. Styloid process. 14. Mastoid tip projected into the shadow of the petrous pyramid. 15. Head of the mandible.



Figs. 5 and 6. Three sclerotic mastoids are shown in Figure 5, in routine lateral (Schueller's) projection. These are of almost identical appearance, and the antra are not demonstrated. Figure 6 shows the same mastoids in axial projection. Complete failure of antrum development in *a*, a narrow, slit-like, cloudy antrum in *b*, a large antral-periantral cavity in *c*. In case *b* at operation granulation tissue was found in the small antrum, in case *c* a chronic purulent-granulating cavity.

- (5) After the tube has been longitudinally centered, measure the distance from the tip of the left mastoid process to the left lateral edge of the cassette on a small ruler.
- (6) Now, standing at the head end of the table, direct the central ray through the left mastoid process by placing the ruler along the upper edge of the cassette and making use of the measurement just obtained. At the same time the central ray should strike the cassette near its longitudinal mid-line. If the centering was done correctly, the central ray will enter the skull above and slightly lateral to the middle of the right eyebrow.
- (7) Use special mastoid cone or narrow extension cone.
- (8) Exposure data on our equipment (four-valve rectified Keleket unit) are: 58-64 kv.; 30 ma.; 1 1/2 seconds; distance 30 inches; intensifying screens; no Potter-Bucky grid.

The special anatomical details more clearly demonstrated in this projection, as compared to those commonly used, are further enumerated and illustrated in Figures 2, 3, and 4 and their legends. It is amazing how clearly the antrum is demonstrated in instances of undeveloped pneumatization or sclerosis of the petrous bone by means of Mayer's projection. Figures 5*a*, *b* and *c* are routine lateral Schueller projections of three different sclerotic mastoids. The roentgenographic appearances are almost identical and practically nothing is seen beyond the general increase in bone density. "Lifting the curtain" by employing the axial projection, we note in Figure 6*a* an almost complete lack of antrum development, in Figure 6*b* a slit-like



Figs. 7, 8, and 9. Axial projections of three different cases of chronic mastoiditis with periantral cavity formation. Figure 7 demonstrates an ill-defined cloudy cavity of moderate size caused by a simple chronic recurrent antrum suppuration. Figure 8 reveals a typical large, smooth-walled cholesteatoma cavity, the posterior canal wall (at 2) is intact. Figure 9 shows an enormous cholesteatoma cavity, now including antrum, attic, and tympanic cavity. The posterior canal wall is totally destroyed. 1. Anterior canal wall. 2. Posterior canal wall. 3. Tympanic cavity and superimposed external auditory meatus. 4. Head of the mandible. 5. Petrous pyramid. 6. Sigmoid sinus. 7. Mastoid emissary. 8. Pathologic cavity.

infantile cloudy antrum, and in Figure 6c a surprisingly large antral and periantral cavity.

When a large central cavity deep in the petrous bone is present, this will show on the routine lateral view, but the axial view will demonstrate it free from interfering bone shadows and will furnish important additional information. It will enable us to judge the presence or absence of cloudiness, the condition of the walls of the cavity, and its relation to neighboring struc-

tures (Figs. 7, 8, and 9). In all cases exact information may be given whether the posterior canal wall is intact or whether it has been destroyed, thus leading to the condition commonly known as "spontaneous radical mastoid" (Figs. 9, 10, and 11). Extension to the osseous capsule of the labyrinth and perforation through the osseous sinus wall into the posterior fossa are important details which are clearly demonstrated (Figs. 10 and 11).

We have to be aware of several impor-



Figs. 10 and 11. Two cases of large cholesteatoma. Figure 10a shows on the routine lateral view of the mastoid a typical, large, smooth, kidney-shaped cavity. Figures 10b and c, the unobstructed axial view, demonstrate that the cholesteatoma has broken through the anterior sinus wall into the posterior fossa, that it extends medially as far as the labyrinth and anteriorly close to the temporomandibular joint. Figure 11a shows a large cholesteatoma on the routine lateral view. Figures 11b and c, the axial view, reveal the cholesteatoma cavity projected out of the disturbing density of the petrous pyramid. The cavity is cloudy in its posterior portion and has broken into the posterior fossa through the sinus wall. A considerable osseous reaction is seen behind the break-through. 1. Head of the mandible. 2. Petrous pyramid. 3. Sigmoid sinus. 4. Cholesteatoma cavity. 5. Area of perforation through the sinus wall into the posterior fossa. 6. Anterior limit of the cholesteatoma, at the same time anterior canal wall. The posterior canal wall is totally destroyed in both cases.

tant limitations in diagnostic interpretation:

(1) Roentgenographic differentiation of an undeveloped, diploic, not diseased mastoid from a chronic sclerosing mastoid without antrum enlargement is not possible on purely roentgenologic criteria. If clinically the ear is diseased, we infer the presence of a chronic sclerosing mastoiditis and can inform the otologist that there is no pathologic cavity deep in the bone and that the antrum is small.

(2) A cholesteatoma which has attained a considerable size is easily diagnosed as such during the quiescent stage by its smooth, regular borderline. During an acute exacerbation, this distinct borderline becomes dissolved and markedly blurred, thus making a differentiation between a granulomatous, purulent enlarged antrum and a cholesteatoma in the stage of acute exacerbation impossible (Fig. 7). No error should be made, however, in reporting



Fig. 12. Postoperative clean cavity following mastoidectomy. Without the clinical data, differentiation from a small quiescent cholesteatoma is not possible. Compare with the cholesteatoma pictured in Figure 8.

the presence, size, and exact position of the cavity in the petrous bone.

(3) A postoperative defect may at times present an appearance similar to that of a

cholesteatoma (Figs. 8 and 12). The clinical history of any previous operative procedure that was followed by an uneventful recovery and permanent disappearance of discharge would decide the differentiation between the two conditions.

In the typical pathologic cases, however, the x-ray findings are so remarkably diagnostic that we may well stand our ground even if the opinion of the otologist should at first be contradictory. The percentage of roentgenological errors is low, once experience in analyzing these films has been gained. All pertinent pathological cases mentioned in this paper have been verified by operation.

CONCLUSIONS

1. The axial projection of the petrous bone described by E. G. Mayer is considered a valuable technic in cases of chronic mastoid disease.
2. The anatomical and technical features of the axial projection of the petrous bone are described and illustrated in detail.
3. The different types and degrees of chronic inflammatory changes at the mastoid antrum are illustrated on cases corroborated at operation.
4. Several differential diagnostic limitations are discussed.

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Photofluorography for Chest Surveys¹

LIEUT. COMDR. MALCOLM W. MASON, (MC) USNR

THE PROBLEM of the detection and control of tuberculosis has been and still is one of paramount importance. Not only is it of interest to the Government, so far as the military forces are concerned, but it is also or should be of considerable concern to the man on the street. Even though great progress has been made in the control of this disease, there remains room for improvement.

We are well aware of the fact that it is of the utmost importance in the control of tuberculosis to find the apparently unsuspected case and to place the subject under supervision and treatment to bring about his cure and prevent the spread of the disease among his associates. The moderately advanced and advanced cases present no great problem, for the symptoms are usually such as to lead the patient to seek professional advice. Even here, however, there are exceptions, as in many moderately advanced cases subjective symptoms are absent.

While we are interested in all types of chest disease, we are primarily concerned with tuberculosis, and especially those patients with minimal lesions. These are the individuals that walk the streets of our cities, ignorant of the fact that they have the disease, unknowingly jeopardizing their own lives and the lives of those with whom they come in contact. We have the means at our disposal to find these cases, namely mass radiological surveys. In years past such surveys were impracticable because of the extreme cost. As a result of improvements in technic and equipment, however, we now have a relatively inexpensive method, *photofluorography*.

This method of examination is practical, adequate, and reliable. Numerous investi-

gators have written upon this subject, giving the general impression of its adequacy. I wish, from my experience, merely to confirm this impression. There is no better way of doing so than by a review of the work done as roentgenologist at the Naval Training Station at Great Lakes.

There are four methods of conducting chest surveys.

The *first* is the use of standard 14 × 17-inch films. Without doubt this is the best method so far as reliability is concerned, especially if stereoscopic views are obtained. It is, however, impracticable for mass surveys because of the expense, lack of speed, and the problem of filing. The estimated cost with this method is approximately a dollar and seventy-five cents per case, which includes the cost of material and upkeep of the machine but not the cost of labor.

The *second* method is the use of 14 × 17-inch paper films. This method is adequate so far as speed is concerned (7 per minute) but has its disadvantages; namely cost, which amounts to about seventy-five cents to a dollar per case, the problem of filing, and the eyestrain involved in reading the films, since indirect lighting must be used and this creates a glare upon the shiny surface of the paper. Furthermore, the reliability is somewhat questionable.

The *third* procedure is the photofluorographic method, using 4 × 5-inch films with stereoscopic views. This I believe to be the most adequate. It is inexpensive, with an estimated cost of approximately ten cents per case, and reasonably rapid (5 per minute); filing is simplified, as the film can be attached to the permanent health record, and the reliability approximates very closely that of the standard 14 × 17-inch film. The percentage of error with this method should be as low as that with the large film. The 4 × 5-inch films can be read without magnification,

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The *fourth* method is that using 35-mm. films. This method is also adequate and reliable; the cost is minimum, approximately three to five cents per case; filing is simplified, as the film can be attached to the permanent health record, and speed is gained (6 to 7 per minute). The size of the film, however, is a slight disadvantage, because of the possibility of missing minimal lesions, especially if they are extremely small, and last, but not least, because of the strain on the eyes of the roentgenologist.

I have had experience with all of these methods, having had the privilege of reading and reporting upon over 5,000 paper films, over 2,000 4 × 5-inch films, and well over 300,000 of the 35-mm. films. This last method was the one used at Great Lakes Training Station.

The equipment at our disposal consisted of a standard 200-ma. x-ray machine with a movable tube stand. The tube was oil-immersed, air-cooled, and had a stationary anode. The photofluorographic unit consisted of a funnel-shaped tunnel with the fluoroscopic screen and grid at the large end and the camera attached at the small end. The camera was a large Leica with a film capacity of 30 feet, with an f 1.5 lens. The screen film distance was 36 inches and the tube film distance 40 inches.

The tube and camera unit were fixed in position. The patient was raised or lowered in front of the screen by means of an electric elevator. Each patient was measured for thickness of the part to be x-rayed, and the kilovoltage and time were varied accordingly. The film used came in 100-foot rolls. This was cut into 33-foot lengths to fit the camera. Each filling accommodated 200 exposures. The developing of the film was relatively simple, standard solutions being used. The time consumed in processing the film, that is developing, fixing, and drying, was usually about one hour.

As a routine, an average speed of 240 cases an hour was maintained, although on a few occasions we reached 420 per hour. It was found that the rate of 240 an hour was most economical from the point of

view of wear and tear on the tube and machine. The average life of a tube was about 57,000 exposures. One tube gave 10,000 exposures, while another gave 140,000. Seven tubes were used for a total of well over 400,000 cases.

The largest number of cases for one day was 3,200 and the largest for any month was 41,989. The speed of interpretation with brief reports was 400 per hour. Our department included 14 x-ray technicians. Six of these men operated the machine and dark room; the others were engaged with the clerical work. The system used was more or less universal throughout the Armed Forces. Each man entering the station had a micro-film taken of the chest. The films were identified with the patient by means of the date and number. The reports for our files were kept on cards giving the name of the man, his company number, date of examination, and a number which corresponded to the number on the film, with a space at the bottom for diagnosis. This card was kept for the permanent files and the micro-film was placed in a small envelope attached to the man's health record, which was sent to the Bureau of Medicine and Surgery in Washington.

If anything of a suspicious or pathological nature was found in the micro-film, the man was called back for a recheck with 14 × 17-inch film. If the diagnosis, now was of pathological significance, the patient was referred to the Naval Hospital for disposition. At the hospital he was again given a thorough examination and his case was submitted to the Board of Medical Examiners for final decision. If this board decided, for example, that the patient had an active case of tuberculosis, he was surveyed from the service and was sent home; the Red Cross notified the Board of Health in his home town of the facts, and they in turn saw that he had proper care and supervision. A careful record of all such cases was kept at the Naval Hospital.

Thus far I have dealt entirely with the technic of the mass survey. I now have a report to submit, based upon 400,263 cases examined with the 35-mm. technic.

These 400,263 cases represent a good cross section of the male population of our country. The men were from all walks of life and from all parts of the country. Their ages ranged from seventeen to forty-five, with the vast majority in the eighteen-to thirty-five-year group. This report is a compilation of the monthly reports that we were obliged to submit to our commanding officer, who in turn submitted them to the Bureau of Medicine and Surgery. These reports had to be accurate and well substantiated.

As to the accuracy of this report we had a definite check. At the end of each month films and reports were returned to our station from the hospital with data concerning correction of diagnosis and disposition of the patient. For a basis upon which to figure percentages, I have chosen two average months, a total of 41,616 cases.

1. Number rechecked by 14 × 17-inch films.....	317 (0.76%)
2. Number sent to hospital for disposition and confirmation of diagnosis.....	112 (35% of rechecks)
3. Number of confirmed diagnoses.	96 (85.7%)
4. Number of diagnoses changed...	16 (14.28%)
(a) Active tuberculosis to inactive tuberculosis.....	7
(b) Pneumonitis to atypical pneumonia.....	3
(c) Active tuberculosis to atypical pneumonia.....	2
(d) Inactive primary tuberculosis of possible future significance to no significance.....	4

The changes of diagnosis listed were not due to the method, as the lesions were discovered on the 35-mm. film and reported as of pathological significance. They may be classified as errors in interpretation.

These 16 errors in judgment are in a way excusable. The diagnoses were made from the x-ray film alone, with no history or other clinical data as an aid. We were well aware of the fact that such diagnoses should not be made with assurance from a single x-ray film. Inasmuch as we had no

choice in the matter, we made our diagnoses as pessimistic as possible, so that the burden of proof rested with the Medical Board at the hospital. Our error was at least on the safe side. Also, we wish to call attention to the fact that of 317 cases rechecked with standard films, only 112 or 35 per cent were sent to the hospital for further examination. In other words, we were using a 65 per cent factor of safety. We do not believe that much was missed under these circumstances.

Since the beginning of the survey, 6 patients with negative diagnoses have been hospitalized with active tuberculosis. Two of these cases were found after two months of service, one after four months, and three after six months. As far as these six cases are concerned, there are two possibilities. *First*, because of the smallness of the x-ray film and the size of the lesion, they were missed or the lesion was seen and an error in diagnosis was made. *Second*, the diagnosis was correct in the first place (namely, negative) and the condition developed after entry into the service. I am unable to say which of the two possibilities applies, but will assume the first to be correct.

There is no doubt that this survey has been of value, not only to the Government but to the patient and contacts in his community. Eight hundred ninety seven (897) of the 400,263 men examined were discharged from the service with tuberculosis. For each case it was estimated that the Government has been saved at least twenty-five thousand dollars, a total of approximately \$22,425,000. All of these cases have been placed under treatment, many of them will undoubtedly become quiescent or arrested, and with proper supervision spread of disease will be prevented.

In conclusion, I am of the opinion that the photofluorographic method of chest survey is inexpensive, reliable, and adequate. Of the two methods, that with 4 × 5-inch film is the better from the standpoint of reliability, as its accuracy very closely approximates the accuracy of the

REPORT OF PHOTOFLUOROGRAPHIC CHEST EXAMINATIONS AT U.S.N.T.S., GREAT LAKES, ILL.*

	Total	Per Cent
1. Number of 35-mm. films taken.....	400,263	
2. Number of check standard 14 X 7-in. films.....	3,775	0.943
3. Number rejected due to x-ray findings.....	1,191	0.298
Tuberculosis.....	897	0.2241
Other findings.....	294	0.074
4. Number of negative findings.....	366,331	91.51
5. Number of abnormal findings.....	33,932	8.49
6. Number of cases of pulmonary tuberculosis.....	27,062	6.76
A-1 Active reinfection type.....	432	0.106
A-2 Inactive reinfection type.....	167	0.0417
B Active primary type.....	6	0.0015
C-1 Inactive primary type of future importance.....	54	0.0135
C-2 Inactive primary type		
(a) Healed primary complex.....	8,806	2.199
(b) Calcified hilum nodes.....	17,838	4.456
(c) Calcified tracheobronchial nodes.....	168	0.0419
D-1 Multiple calcifications and massive calcification of hilum.....	193	0.0482
D-2 Miliary calcifications in lung parenchyma.....	246	0.0615
E Fibrinous and serofibrinous pleuritis.....	79	0.0197
7. Other diagnoses made whether cause for rejection or not (35-mm.)		
Cardiac enlargement and abnormal configuration.....	2,169	0.542
Tortuous aorta.....	27	0.0067
Dextrocardia.....	62	0.0155
Prominent pulmonary conus.....	314	0.0784
Atelectasis.....	19	0.0047
Bronchiectasis.....	26	0.0065
Pneumothorax (spontaneous).....	10	0.002498
Pneumoconiosis.....	10	0.002498
Atypical pneumonia.....	119	0.0297
Hemothorax.....	1	0.0002498
Pulmonary abscess.....	2	0.0004996
Emphysema.....	3	0.00075
Thickened or calcified pleura.....	51	0.0127
Azygos lobes.....	411	0.103
Lung cyst.....	2	0.0004996
Elevation of diaphragm.....	96	0.024
Diaphragmatic adhesions.....	174	0.0434
Tumor of diaphragm.....	1	0.0002498
Eventration of diaphragm.....	26	0.0065
Lung tumor.....	4	0.00099
Mediastinal tumors.....	38	0.0095
Substernal thyroid.....	1	0.0002498
Pericardial adhesions.....	3	0.00075
Fractured ribs.....	28	0.00699
Anomalies of ribs.....	1,715	0.4284
Cervical ribs.....	238	0.0594
Rib tumors.....	5	0.0013
Rib resection.....	35	0.0087
Congenital absence of ribs.....	1	0.0002498
Ununited fractured clavicle.....	4	0.00099
United fractured clavicle.....	19	0.0047
Metallic foreign body in thorax.....	3	0.00075
Calcified cervical nodes.....	5	0.0013
Foreign body in shoulder.....	4	0.00099
Ununited epiphysis, scapula.....	1	0.0002498
Congenital deformities of the spine.....	8	0.0019
Thirteen thoracic vertebrae and 13 ribs (bilateral).....	1	0.0002498
Scoliosis (simple).....	1,142	0.285

Hypertrophic arthritis of spine.....	4	0.00099
Hemivertebrae.....	25	0.00624
Fractured vertebrae.....	3	0.00075
Spina bifida, thoracic and cervical.....	6	0.0015
Megacolon (from chest film, proved by abdominal film).....	5	0.0013

* Credit is given to Lieut. (jg) H. M. Weiselber, Lieut. Comdr. J. W. Jones Lieut. Comdr. M. A. Thomas, Lieut. Comdr. G. M. Picciochi, and Comdr. T. G. Clement, who examined some of these cases.

14 X 17-inch standard film method. But even though the accuracy of the 35-mm. method does not approach that attained with the larger films, it is adequate enough for practical purposes. At the present time surveys are being conducted in industrial plants and in some community public schools. These do not reach the entire population. It is not inconceivable, however, that a system can some day be devised through which the entire population of a given community can be surveyed, with the result that active cases can be so isolated and so supervised that eventually the incidence of tuberculosis will become insignificant.

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cular Disease," B. C. Smith, M.D., and Edith H. Quimby, Sc.D.; "Streamlining X-Ray Therapy for War Time Service," Capt. Albert Soiland; "X-Ray Demonstration of Cecal Deformity in Amebiasis," Ross Golden, M.D., and P. H. Ducharme, M.D. The paper of Doctor Hilleboe and Doctor Morgan outlined the proposed objectives of the Public Health Service in regard to surveys for case finding in tuberculosis.

The Wednesday afternoon diagnostic papers were concerned wholly with bone and joint disease: "Differential Diagnosis of Tuberculosis in Joints of the Extremities," Raymond Lewis, M.D.; "Derangements of the Knee: The Diagnostic Scope of Soft Tissue Examination with the Vacuum Technic," Lt. Comdr. J. Gershon-Cohen; "Post-Traumatic Para-Articular Calcifications and/or Ossifications of the Ankle," Capt. A. D. Piatt; "Development of Bone Sarcoma Following Irradiation," C. H. Hatcher, M.D., "Lesions of the Intervertebral Disk in the Cervical Region," J. E. Whiteleather, M.D., R. E. Semmes, M.D., and Maj. Francis Murphey; "Roentgenologic Observations in Age Atrophy of the Spine," G. J. Marum, M.D.; "Deossifications Regional to Joints of Extremities," Col. A. A. de Lorimier, H. B. Boyd, M.D., and W. L. Minear, M.D.

The therapy papers presented on Wednesday afternoon were: "Roentgen Therapy for Brain Tumors," Percival Bailey, M.D., and T. J. Wachowski, M.D.; "Roentgen Therapy of Primary Neoplasms of the Brain and Brain Stem," A/Surgeon Comdr. C. B. Pierce, W. V. Cone, M.D., A. R. Elvidge, M.D., and J. C. Tye, Jr., M.D.; "Neurosurgical Treatment of Patients with Advanced Malignant Diseases," Gayle Crutchfield, M.D.; "Irradiation of Pituitary Tumors," W. S. Lawrence, M.D.; "Roentgen Therapy of Encephalitis," U. V. Portmann, M.D., and Roger Lough, M.D.; "Simplification of Tissue Dosage Estimation in X-Ray Therapy," Anna Hamann, M.D.

The general program Thursday morning

included: "The Morgan X-Ray Exposure Meter and Phototimer," P. C. Hodges, M.D.; "Scout Film of the Abdomen," Lt. Col. Joseph Levitin; "Clinical Cineradiography—Brazilian Method," Dr. W. de Toledo Piza and Dr. José Jany, of São Paulo, Brazil; "Analysis of Factors Affecting the Diagnostic Quality of the Roentgen Image," R. H. Morgan, M.D.; "Importance of Recognizing Protrusions of the Gastric Mucosa in Military Personnel," Comdr. Wendell Scott; "Abdominal Aortography—A New Simplification of the Technic," Pedro L. Fariñas, M.D., of Habana.

The Thursday afternoon Section on Diagnosis offered: "The Roentgen Anatomy of the Skull in the Newborn Infant," S. G. Henderson, M.D., and Louise M. Sherman, M.D.; "Mid-line Anomalies of the Brain," A. P. Echternacht, M.D., and J. A. Campbell, M.D.; "Lesions of the Aqueduct of Sylvius," Hugh Wilson, M.D., and W. G. Lutz, M.D.; "Fibrous Dysplasia of the Bones of the Skull," D. G. Pugh, M.D.; "Observations on the Presence of Subdural Gas after Pneumoencephalography," L. W. Paul, M.D., and T. C. Erickson, M.D.

In the Therapy Section on Thursday were heard: "Results of Irradiation of Ovarian Tumors," H. D. Kerr, M.D., and R. A. J. Einstein, M.D.; "The Problem of Secondary Infection in Carcinoma of the Cervix," Manuel Garcia, M.D., and J. V. Schlosser, M.D.; "Irradiation Failures in Early Carcinoma of the Cervix—Is Surgery or Irradiation Preferable?" Franz Buschke, M.D., and S. T. Cantril, M.D.; "Indications and Limitations of Transvaginal Roentgen Therapy for Cancer of the Cervix," A. W. Erskine, M.D.; "Bone Tumors: Review of Cases from Bellevue Hospital, New York," Rieva Rosh, M.D., and Louis Raider, M.D.

Thursday evening we enjoyed a fine banquet, guided by Ed Jenkinson, as toastmaster, through an array of speeches and bows by the new officers of both societies. The speaker of the evening was Franklyn B. Snyder, Ph.D., President of

Northwestern University. His address was one of the finest we have had the privilege of hearing. His theme, illustrated by an incident from early American history, was that ignorance of nature and of human relations is the basis of most of the troubles of the individual and of society. The recognition of these two weaknesses points the way to a solution of many of our pressing problems.

The last morning session, Friday, included: "Osteochondritis Dissecans of the Supratrochlear Septum of the Humerus," A/Surgeon Lt. Comdr. W. E. Crysler and Surgeon-Comdr. H. S. Morton; "Subcortical Cyst-like Lesions of Joints," D. B. Phemister, M.D.; "Cardiac Changes in Arteriovenous Fistula," Maj. R. C. Pendergrass; "Cystourethrography," F. O. Coe, M.D.; "Roentgenologic Aspects of Therapeutic Pneumoperitoneum," E. A. Schmidt, M.D.; "Topical Anesthesia in Gastrointestinal Spasm, a Diagnostic Aid." L. A. Smith, M.D.

The final Diagnostic Section presented: "Roentgen Appearances in Collapse of the Lung and Its Subdivisions: A Preliminary Report," L. L. Robbins, M.D., and C. H. Hale, M.D.; "Gas Gangrene," Capt. M. D. Sachs; "Extra-Pleural Pneumothorax in the Treatment of Pulmonary

Tuberculosis: Three to Five Year Follow Up of 48 Cases," F. H. Alley, M.D.; "Some Experiences with Angiography," E. A. Miller, M.D.; "Specifications for the Fluoroscopist's Dark Adaptation Goggles," W. E. Chamberlain, M.D., and Ann Chamberlain; "Unusual Urinary Calculi," E. J. Bertin, M.D.

The closing Therapy Session offered: "The Treatment of Hemangiomas," G. E. Pfahler, M.D.; "Treatment of Hemangioma with Roentgen Rays," J. V. Prouty, M.D.; "Cancer of the Skin," H. J. Ullmann, M.D.; "Post-irradiation Cutaneous Necrosis," H. B. Hunt, M.D., and D. H. Breit, M.D.; "The Radon Ointment Treatment of Irradiation Ulcers," R. E. Fricke, M.D., and M. M. D. Williams, Ph.D.; "Evaluation of Roentgen Therapy for Filariasis," Lt. H. L. Jaffe.

The smoothness with which everything moved and the enthusiasm of those in attendance are a tribute to the hard work that was done by the Coordinating Committee, Doctor Jenkinson, Doctor Kinney, Doctor Portmann, and Doctor Witwer, its Chairman. To them and to all who contributed to this successful meeting go our heartfelt thanks and appreciation.

S. J. HAWLEY, M.D.

The Scientific Exhibits

In spite of the heavy demands on the radiologist in a nation at war, more than eighty exhibitors were represented in the scientific exhibits at the Joint Meeting of the two radiological societies. The exhibits are listed below:

WILLIAM S. ALTMAN, M.D., AND HARRY F. FRIEDMAN, M.D. (*Boston, Mass.*): Treatment of Superficial Hemangioma with Contact Therapy. Dr. Altman and Dr. Friedman used kodachrome slides showing superficial hemangiomas before and after application of contact therapy. The kodachromes were of small and extensive lesions and were of excellent quality, graphically demonstrating the color

changes obtained by this method of treatment.

MELVIN ASPRAY, M.D. (*Spokane, Wash.*): Hemangiomas of the Liver. With a few 14 × 17" films made in one case, Dr. Aspray called attention to a rare sunburst type of calcification in the liver which is typical of hemangiomas of that organ and is comparable to a similar finding in hemangiomas in skulls, as pointed out by Bucy and Capp.

E. C. BAKER, M.D., S. H. SEDWITZ, M.D., AND F. A. MILLER, M.D. (*Youngstown, Ohio*): Venographic Patterns of the Lower Extremities. Normal and abnormal venographic patterns were demonstrated

by meticulous drawings accompanying the original films. Several examples of thrombosis and methods of abnormal return of blood from thigh to body were shown by Dr. Baker and his associates.

C. C. BIRKELO, M.D., AND WILLIAM BROSIUS, M.D. (*Detroit, Michigan*): Post-mortem Roentgenograms of the Lung. Using the original 14 × 17" films, Drs. Birkelo and Brosius demonstrated roentgenographic findings in various types of pulmonary diseases and, with accompanying roentgenograms made after necropsy, showed the lungs in these cases inflated to antemortem volume. They thus made a comparative study frequently clarifying obscure roentgen findings.

HAROLD B. BOYD, M.D., W. L. MINEAR, M.D., AND COL. A. A. DE LORIMIER, M.C. (*The Willis C. Campbell Orthopedic Clinic, Memphis, Tenn.*): Deossifications Regional to Joints of the Extremities. This exhibit represented a study of more than 200 cases of deossification in extremities. An attempt was directed toward identifying etiological factors related to the several types of deossification. The changes were found secondary to trauma, following infections, and associated with neoplasms and prolonged disuse.

SAMUEL BROWN, M.D. (*Cincinnati, Ohio*): Case Reports. A miscellaneous group of unusual and interesting cases was demonstrated, in which the diagnosis was determined largely by roentgenographic methods.

FRED O. COE, M.D., AND P. S. ARTHUR, M.D. (*Washington, D. C.*): Cysto-Urethrography in Diagnosis of Prostatic Disease. A technic of graphic demonstration of normal and pathological conditions in bladder and urethra was illustrated in a series of thirty 10 × 12" reduction films. The pathological conditions were largely those of the prostate affecting the bladder and urethra.

LEWIS GREGORY COLE, M.D. (*White Plains, N. Y.*): Pathogenesis versus Cytology in the Differentiation of Ulcers from Cancer. This exhibit represented a method of microscopic diagnosis of ulcerat-

ing gastric neoplasm based on pathogenesis or the mode of development of the lesion, regardless of the cytological characteristics of the cells. Twenty-five microscopic criteria of neoplasm were observed that were direct antitheses of those observed in simple inflammatory ulcers.

COL. A. A. DE LORIMIER, M.C., A.U.S. (*The Army School of Roentgenology, Memphis, Tenn.*): The Layout of the Army School of Roentgenology. Photographic views of the medical center, the school building, and a variety of views pertinent to training activities were shown in an interesting and instructive collection.

COL. A. A. DE LORIMIER, M.C., A.U.S., AND CAPT. C. A. HALLIN, M.C., A.U.S. (*The Army School of Roentgenology, Memphis, Tenn.*): Auxiliaries for the U. S. Army Field Table Units. The regular field table of the Army was shown with an x-ray machine unit and the auxiliary attachments mounted. With this were shown a small motor mechanism, a serialographic attachment, and a new bi-plane marker.

LILIAN DONALDSON, M.D., AND SYLVIA BENSLEY, M.D. (*University of Chicago, Chicago, Ill.*): An X-Ray Museum for the Teaching of Medical Students. This exhibit was a demonstration of the methods used in the University of Chicago, Department of Medicine, Division of Roentgenology, for the teaching of anatomy and clinical medicine, including radiology.

PEDRO L. FARÍÑAS, M.D. (*Habana, Cuba*): Abdominal Aortography: A New Simplification of the Technic. A most interesting collection of roentgenograms was shown, illustrating different pathological conditions of the abdominal aorta and its main branches. There was a photograph of the instruments used in the procedure, and a chart giving a brief description of the method was shown.

LIEUT. COL. EUGENE FREEDMAN, M.C., A.U.S., CAPT. S. MESCHAN, M.C., A.U.S., AND LESLIE LOVE, M.D. (*Dibble General Hospital, Menlo Park, Calif.*): Hydatid Cysts. An excellent collection of films from several hospitals in Australia was

shown, demonstrating the radiologic appearance of hydatid cysts in the lungs, pleura, pericardium, liver, spleen, mesentery, kidneys, and various bones.

MAJOR MILTON FRIEDMAN, M.C., A.U.S., AND LIEUT. COL. LLOYD LEWIS, M.C., A.U.S. (*Walter Reed General Hospital, Washington, D. C.*): Improved Technic for the Treatment of Carcinoma of the Testis. In this exhibit an excellent group of charts, diagrams, color photomicrographs and color photographs was used to illustrate the following factors: (1) study of the lethal tumor dose based on histologic examination of tumors exposed to various quantities of radiation; (2) operative investigation of the distribution of retroperitoneal nodes in relation to the size and duration of the primary tumor; (3) the precise technic of irradiation, including location of the portals and determination of the exact tumor dose to retroperitoneal nodes at different levels.

LOWELL S. GOIN, M.D. (*Los Angeles, Calif.*): Combined Surgical and Radiation Therapy in Cancer of the Bladder. This exhibit was in the form of a 16-mm. kodachrome movie film depicting a method used by Dr. Goin in treating with low-voltage contact therapy certain bladder tumors. Careful selection of cases as to size and location of the tumor preceded the surgical exposure and removal of most of the growth by electrocoagulation. The base of the tumor was then irradiated by direct contact on one or two occasions. Thirty-one patients were treated. Of these, 27 per cent are reported living, either with or without cancer.

JEAN A. GROH, M.D. (*Cleveland, Ohio*): The Arc-Welder's Lung. A series of twelve chest films was shown depicting the typical findings in a chest survey of 83 arc welders in one industrial firm. A peculiar soft mottling was present in the films of 71 per cent of these workers and, on the basis of previous work by other investigators, was interpreted as iron oxide staining. The importance of recognizing the condition as harmless and differentiating it from other similar findings was stressed.

LIEUT. COL. JOHN B. HAMILTON, M.C., A.U.S., MAJOR JOHN L. BARNER, M.C., A.U.S., AND CAPT. PUTNAM C. KENNEDY, M.C., A.U.S. (*An Army General Hospital, Atlanta, Ga.*): Interesting Bone Lesions. This was a very interesting and instructive collection of films showing various bone lesions encountered in the roentgenological service of a military general hospital. The lesions were classified in four groups: tumors, infections, systemic conditions, and a miscellaneous group.

HARRY HAUSER, M.D., AND C. C. DUNDON, M.D. (*Cleveland, Ohio*): Miniature Chest Fluorography with Control Study. This exhibit demonstrated in a graphic manner the value of stereoscopic 4 × 5" miniature fluorographs in a control study of one thousand apparently healthy adult chests, utilizing both conventional and miniature methods in each case.

SAMUEL G. HENDERSON, M.D., AND LOUISE S. SHERMAN, M.D. (*Pittsburgh, Penna.*): The Roentgen Anatomy of the Skull in the Newborn Infant. A very fine series of sixty films was shown, demonstrating the anatomy of the skull of the newborn infant, together with certain normal variations of the common pattern of the bony structures. *Honorable mention was awarded this exhibit.*

PAUL S. HENSHAW, M.D. (*Bethesda, Md.*): Radio-Leukemia. Experimental induction of leukemia in mice with x-rays was shown in a striking manner in this exhibit. It was a pictorial demonstration, showing how the incidence of leukemia varies with the dose of the radiation applied, and something of the hematologic and histologic changes that occur preceding the full-blown disease. Material was also presented showing the incidence of leukemia in physicians, the relationship of radiation as a carcinogenic agent to other carcinogens, and the amount of ionization produced in tissues by a certain exposure. *This exhibit received the Third Award.*

J. F. HOLT, M.D., AND FRED JENNER HODGES, M.D. (*Ann Arbor, Mich.*): Bones of the Hands, An Index of Local and Systemic Disease. This was a well-planned

and instructive exhibit demonstrating about twenty-six diseases or systemic conditions which produce roentgenological evidence in bones of the hands.

JOSÉ JANY, M.D., JOAQUIN MARTINS GARCIA, M.D., AND CAPT. FRANCO (*São Paulo, Brazil*): Clinical Cineradiography: Brazilian Method. An interesting short movie demonstrated a method of cineradiography employed in Brazil. Several excellent cineradiographic films were shown.

WAYNE A. JOHNSTON, M.D., AND JULIUS HEYDEMANN, M.D. (*Dubuque, Iowa*): Pulmonary Mycosis. This exhibit showed pulmonary mycosis found and diagnosed in a town of the Middle West. It demonstrated the similarity of the roentgen findings in all of the cases and showed that these are quite informative, although not diagnostic in themselves.

CARL LIST, M.D., CURTIS BURGE, M.D., AND FRED JENNER HODGES, M.D. (*Ann Arbor, Mich.*): Cerebral Angiography. An excellent collection of films showing various lesions depicted by intracranial angiography was presented in this exhibit. Examples of angiograms illustrating stereoscopic film pairs made during the arterial and venous phases of circulation were shown. Combined arteriograms and ventriculograms graphically demonstrated certain intracranial derangements.

EDWARD E. MANSUR, M.D. (*Jefferson City, Mo.*): Anatomical Relationship of the Ureters to the Cervix and Uterus in the Female Pelvis as Shown by Film Negatives. This exhibit, utilizing a few films, demonstrated very clearly the relationship of the ureters to the cervix and uterus in the female pelvis.

EARL R. MILLER, M.D. (*San Francisco, Calif.*): Angiography. This was a very informative collection of films depicting opacification of vessels for demonstration of necrosis, cardiac and arterial anomalies and diseases. Demonstration of peripheral circulation by these methods called attention to the possibility of diagnosing many lesions in the periphery of the body by this method.

RUSSELL H. MORGAN, M.D., AND ENSIGN HARRY LONG, U.S.N. (*U. S. Public Health Service and Medical Department, U.S.N., Washington, D. C.*): Automatic Methods for Photofluorography. This exhibit showed a 35-mm. photofluorograph equipped with an automatic photo-electric timing mechanism (phototimer) and an automatic 35-mm. camera. The operation is spectacularly simple, requiring only the proper centering of the subject and the closure of the exposure switch. The phototimer terminates the exposure at the instant the film has received the correct quantity of radiation to insure optimal diagnostic quality, and on the completion of the exposure the camera automatically moves the film to the next frame, preparing the photofluorograph for the next exposure. The phototimer was designed and developed with the co-operation of the Office of Scientific Research and Development in the Division of Roentgenology, University of Chicago. The automatic camera was designed and developed at the U. S. Naval Medical Center, Bethesda, Md.

SURGEON COMMANDER H. S. MORTON, AND A/SURGEON LIEUT. COMMANDER W.E. CRYSLER (*Royal Canadian Navy, Ottawa, Canada*): Osteochondritis Dissecans of the Supratrochlear Septum (Humeri). The roentgenologic features of osteochondritis dissecans of the supratrochlear septum of the humerus were demonstrated in reproductions of films and photomicrographs from six cases. The roentgenographic findings were those of a separate ossicle of bone arising from the supratrochlear septum in various degrees of sequestration.

A/SURGEON COMMANDER C. B. PEIRCE, A/SURGEON LIEUT. COMDRS. BOUCHARD, McRAE AND VAUGHAN, SURGEON-LIEUTENANTS BROOKE, GREENE, AND STAPLETON (*Royal Canadian Navy, Ottawa, Canada*): Arthrography of the Knee. This very fine exhibit of arthrographs demonstrated various derangements and lesions of the knee joint, especially as affecting the semilunar cartilages. The methods employed in the several Royal Canadian Naval

Hospitals were shown with their resultant roentgenograms. *This exhibit received Honorable Mention.*

EUGENE P. PENDERGRASS, M.D., JOHN Q. GRIFFITH, JR., M.D., NICHOLAS PADIS, M.D., AND ROBERT P. BARDEN, M.D. (*Philadelphia, Penna.*): Pituitary Irradiation Controlled by Biologic Tests. By means of charts, photographs, and drawings, the exhibitors illustrated their experiences with pituitary irradiation in 142 cases of arterial hypertension. They demonstrated (1) a method of bioassay for certain pituitary hormones, particularly the antidiuretic hormone; (2) the effect of pituitary irradiation in the development of such hormones; (3) effect of irradiation on the pituitary in arterial hypertension cases which are selected on the basis of hormonal bioassays; (4) the effect of irradiation on adjacent brain tissue. *This exhibit received First Award.*

LIEUT. COL. ROBERT C. PENDERGRASS, M.C., A.U.S. (*Ashford General Hospital, White Sulphur Springs, West Va.*): Cardiac Changes in Arteriovenous Fistula. This was an informative and nicely planned exhibit demonstrating changes in cardiac size with arteriovenous fistula, with a comparison of heart size before and after surgical closure of the fistula. Gradual development of cardiac enlargement following war wounds producing arteriovenous fistulae was demonstrated. The effect of compression of the fistula on the heart was illustrated.

ERNST A. POHLE, M.D., L. W. PAUL, M.D., AND E. A. CLARK, M.D. (*Madison, Wis.*): Roentgen Therapy of Boeck's Sarcoid. Selected films from a series of fifteen cases of Boeck's sarcoid treated with roentgen rays were shown. Irradiation in doses comparable to those commonly used in treatment of inflammatory disease was employed, with apparent beneficial results in some patients.

CAPT. HUBERT J. PRICHARD, M.C., A.U.S., CAPT. RICHARD E. KINZER, M.C., A.U.S., AND CAPTAIN MEDLIN, M.C., A.U.S. (*Washington, D. C.*): Chest Pathology Encountered at Induction Sta-

tions. This was an informative and interesting exhibit of the latest photoroentgen equipment used by the U. S. Army at induction stations, together with an extensive collection of films depicting the varied chest lesions encountered at these stations. Both regulation stereoscopic 14 × 17" films and 4 × 10" films of the same case were demonstrated, showing the remarkable constancy of the latter in exhibiting the same details as the regulation 14 × 17" stereoscopic studies.

LAWRENCE REYNOLDS, M.D., AND ASSOCIATES (*Harper Hospital, Detroit, Mich.*): Roentgen Demonstration of the Semilunar Cartilage of the Knee Joint and of Injuries to This Cartilage. Charts, photographs, and films were used to illustrate in an excellent manner a method of demonstrating roentgenographically normal and abnormal medial menisci of the knee joint. The technic of this examination in the hands of the authors appears fairly simple and affords an excellent method of demonstrating disorders involving the semilunar cartilage.

LEO G. RIGLER, M.D., HENRY S. KAPLAN, M.D., AND CAPT. DANIEL L. FINK, M.C., A.U.S. (*Minneapolis, Minn.*): Tumors of the Stomach and Pernicious Anemia. A splendid series of films was shown illustrating the relationship of benign to malignant tumors of the stomach and their association with pernicious anemia. Routine semiannual roentgen examination of the stomach in patients with pernicious anemia and material from a large autopsy series in pernicious anemia cases would seem to confirm the opinion that there is a far greater incidence of gastric tumors in patients with pernicious anemia than in the remainder of the population.

LAWRENCE L. ROBBINS, M.D., AND CLAYTON H. HALE, M.D. (*Boston, Mass.*): Roentgen Appearance in Collapse of the Lung and Its Subdivisions. This exhibit was an excellent demonstration of the diagnostic points in recognizing collapse of the lung and its subdivisions by means of various roentgenograms. The films shown were representative of a detailed

study of 900 chest examinations in which there was some evidence suggesting collapse of one or more lobes or segments of lobes of the lung. *Second Award was given this exhibit.*

CAPT. ALBERT SOILAND, M.C., U.S.N.R., WM. E. COSTLOW, M.D., AND ORVILLE N. MELAND, M.D. (*Los Angeles, Calif.*): Third Dimensional Roentgenographic Studies of Soft Tissue. This exhibit portrayed a method of producing soft-tissue roentgenograms having depth perception. The method is advocated as a substitute for single flat films when the parts to be examined are subject to involuntary motion. Two films placed in a special cassette are exposed simultaneously to produce stereoscopic vision.

ROBERT B. TAFT, M.D. (*Charleston, S. C.*): Radium Contamination of Film Boxes. This was a most interesting and informative exhibit, tracing certain black spots in films after development to the effect of tiny bits of radioactive material in the pasteboard of the film box. The source of these radioactive substances was found to be waste paper on which paint brushes carrying forms of luminous paint had been cleaned. *Honorable Mention was given to this exhibit.*

HENRY K. TAYLOR, M.D. (*New York, N. Y.*): Aseptic Necrosis in Adults. This splendid exhibit displayed many examples of the roentgenographic evidence of bone infarcts and areas of aseptic necrosis occurring in fourteen caisson and thirty-five non-caisson workers. The lesions in both

groups present roentgenographic appearances which are similar and at times cannot be differentiated one from the other.

H. S. VAN ORDSTRAND, M.D., ROBERT HUGHES, M.D., J. M. DENARDI, M.D., AND MORRIS G. CARMODY, M.D. (*Cleveland, Ohio*): Poisoning in Beryllium Production. This was an excellent exhibit demonstrating the clinical and pathological findings in workers processing beryllium from the raw ore. Respiratory, dermatological, and ocular manifestations were shown. A chemical pneumonitis was demonstrated in many cases and autopsy material from four fatal cases was studied.

MARY FRANCES VASTINE, M.D., EDWIN L. LAME, M.D., FRANK S. CLARKE, M.D., AND LAURENCE B. RENTSCHLER, M.D. (prepared under direction of EUGENE P. PENDERGRASS, M.D., AND JACOB H. VASTINE, 2ND, M.D., *Philadelphia, Pa.*): The Hip Joint—Roentgenologic Aspects of Pathology in This Region. This was a very inclusive and instructive exhibit of the roentgenographic evidence of varying conditions which can affect the hip joint.

FRANK WINDHOLZ, M.D. (*San Francisco, Calif.*): Tissue Changes in the Cancerous Larynx After Protracted and Fractionated Irradiation. In this exhibit photomicrographs were shown illustrating tissue reactions in ten larynges at different times after irradiation. The histology of the fibrinous reaction, healing of the tumor, perichondritis, changes in the epithelial, connective and muscle tissues were shown.

CLARENCE E. HUFFORD, M.D.

The Commercial Exhibits

As a result of the splendid co-operation of thirty exhibitors, the space reserved for commercial exhibits at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America was filled almost to overflowing. The exhibit space was adjacent to the scientific exhibits, and it was necessary to pass through it to reach the ballroom,

where the morning sessions and the afternoon diagnostic sessions were held. The attendance at the commercial exhibits was excellent, giving the exhibitors an opportunity to demonstrate new equipment and methods, to renew old friendships, and to make new contacts with the more than 1,300 members and guests registered at the meeting.

Your roving reporter (Chairman of the Commercial Exhibit Committee) attempted to make notes on all the exhibits, but the material was so extensive that it was impossible not to miss some points of interest. To appreciate the quality and extent of the exhibits, it is necessary to see them for oneself. Not to spend considerable time in the commercial exhibit section is to miss an important part of our scientific meetings.

Many of the exhibitors have been producing materials of great value to the war effort, which for reasons of security they could not show, but the quality of the equipment displayed was up to pre-war standards, and the extent of the exhibits indicated that the difficulties in the shipping situation, which interfered with the size and quality of the exhibit at the 1942 meeting, had been largely overcome.

A brief note concerning each of the exhibits follows:

AnSCO: In addition to the excellent line of photographic materials shown by AnSCO, there were also exhibited specimens of the machine work turned out in their shops for the ordnance departments of our Armed Forces.

Buck X-ray Company demonstrated complete film processing tank layouts, with thermostatic controls. A new development, shown in the central portion of their exhibit space, was an ingenious wet film transfer cabinet for viewing wet films. Mr. Buck was in immediate charge of the exhibit.

Canadian Radium & Uranium Corporation: This exhibit demonstrated radium and its applications from the ore to the finished product. Of especial interest was the radon-containing ointment which is being used in the treatment of radiation injuries and other intractable conditions.

E. I. du Pont de Nemours & Co., Inc.: An extensive exhibit of du Pont products, of which there is an extremely varied assortment, was shown. A large spindle of Nylon thread brought forth many expressions of interest, especially from the lady

visitors. Carl Patterson (Patterson Screens), an important addition to the du Pont Company, was on hand.

Eastman Kodak Company: The use of "Kodacolor aero reversal film" in aerial photography was strikingly demonstrated by a long strip color photograph shown in a special demonstration at the front of the booth. Films and chemicals for various purposes were shown, and it seemed like old times to have a few new Kodaks for the photographic fans to examine.

Eureka X-Ray Tube Corporation: This well-known manufacturer showed a complete line of tubes for all types of x-ray work. Cross-section samples to show ruggedness of construction made it plain why the tubes manufactured by this company have gained an enviable reputation.

General Electric X-Ray Corporation: An excellent showing of the G. E. line of x-ray equipment required one of the largest exhibit spaces on the floor. Many types of diagnostic and therapeutic equipment were displayed. One item which received much attention was the recently developed dictating and repeating instrument, about the size of a portable radio receiver, which "takes down" either words or music with equal ease by magnetizing a rapidly moving fine wire, and then, on the turn of a switch, "repeats it back to you." The future doubtless holds many uses for this invention.

Kelley-Koett Manufacturing Co.: Another large exhibit space was used by Kelley-Koett for the display of equipment and supplies. Items such as a high-voltage therapy machine, Bucky motor-drive tilt tables, diagnostic generators and controls, and accessories showed that this company has allowed no relaxation of the high standards of quality which it has maintained for years.

Lea & Febiger, publishers, exhibited a selected display of their publications which proved of considerable interest to the physicians attending the convention. Even a partial list of the books exhibited would be too long to include here, but Dyke and Davidoff's "Roentgen Treatment of Dis-

eases of the Nervous System" and the second edition of Master's "The Electrocardiogram and X-ray Configuration of the Heart" were frequently examined by the visitors. Over fifty other works were exhibited by Mr. L. E. Drury.

Liebel-Flarsheim Co.: The Bucky diaphragms and grids which this company constructs for many x-ray equipment manufacturers are well known to all radiologists, and were well explained at its booth.

Machlett Laboratories: This exhibit included the introduction to the public of a new hermetically sealed, precision type 2,000,000-volt x-ray tube, of relatively small size considering its capacity, and a wonderful example of engineering and construction. It has a $1/100$ " focal spot, providing for the first time a practical super-voltage x-ray tube for radiography of heavy objects and for therapy. Special tubes with beryllium windows, as well as Machlett rotating and stationary anode tubes, of a quality well known to all radiologists, were also displayed.

F. Mattern Manufacturing Co. exhibited its line of up-to-date diagnostic x-ray equipment. Though this company is something of a newcomer in the x-ray field, its products have had a good reception. It featured automatic controls and safety devices to prevent overloading of circuits. The number of visitors to the exhibit indicated the interest in these products.

The Medical Bureau was efficiently handled by Miss Burneice Larson and her co-operative assistants. Inquiries for professional assistants and technical employees were handled and placement of those searching for opportunities was furthered. Those attending this type of meeting have found it to their advantage to be able to discuss such matters directly rather than by mail.

National Synthetics: Products for the visualization of the gallbladder were featured in this exhibit. Both intravenous and oral dye preparations, in various dispensing units, tablets, and powders were shown. The use of the new preparation

"Dikol" and the gallbladder stimulant "Cholex" was promoted by a special offer on quantity purchases during the meeting. Of special interest was a series of films demonstrating results of a new opaque medium for oral administration, still unmarketed, which showed possibilities for demonstration of the genito-urinary system with simultaneous gallbladder visualization within six hours.

Newman X-Ray Corporation, a new exhibitor at our meetings, showed a wide line of diagnostic x-ray equipment. The statement that none of their equipment is based on prewar engineering seemed warranted by its up-to-date appearance and operation.

North American Philips Co., Inc.: The feature of this exhibit was the apparatus for contact and cavity therapy. This type of equipment has recently been coming into use, for the treatment of many accessible lesions, to quite an extent, and the exhibit attracted much interest.

Pako Corporation: A completely automatic processing setup which will turn out a finished film every minute, as long as the feeding device is kept loaded with exposed films, was an interesting exhibit demonstrated in motion. It would seem that this equipment might be the answer for a busy darkroom where several technicians are required but are not available under present conditions.

Picker X-Ray Corporation: Presided over by the genial Mr. Picker himself, the Picker exhibit attracted many visitors. An extensive showing of equipment and supplies, from their smaller machines up to the heavy duty diagnostic equipment with their well known "Monitor" controls, was made.

Powers X-Ray Products Co., manufacturers and distributors of sensitized paper, announced the availability of "Powers x-ray paper" to the medical profession at approximately one-half the cost of celluloid.

Radiology: A booth was used to introduce our well known journal to those not yet acquainted with it. Presided over ably

by representatives of the editorial staff, it was a very definite attraction. A booklet of "Instructions to Authors," containing much useful information on the preparation of illustrations, was a popular feature.

Radium Chemical Company: An extensive exhibit of instruments and applicators for the use of radium was shown. A new type of plastic applicator may well prove to be of considerable importance.

Schering Corporation: The space occupied by this corporation was used to demonstrate many products of interest to the medical profession. Hormones of various types were shown. Of especial interest to radiologists was Neo-Iopax for intravenous urography and the new Priodax for cholelithography.

Sola Electric Co., manufacturers of constant voltage transformers, brought their products directly to the attention of the radiologists at this meeting. These transformers are built to deliver an even flow of current to the machine with which they are used. The use of constant voltage transformers in x-ray equipment should prove to be of considerable value in the future.

Standard X-Ray Co. demonstrated an extensive line of x-ray equipment. Prominently displayed were the shock-proof model F-30 mobile and portable unit and the model F radiographic and fluoroscopic tilting table.

Charles C Thomas, publisher, had on exhibit his latest books. Many were of special interest to those attending this meeting—to mention only two: Paneoast, Pendergrass and Schaeffer: "The Head and Neck in Roentgen Diagnosis"; Donaldson: "The Roentgenologist in Court."

Victoreen Instrument Co. demonstrated their well-known x-ray measuring instruments. The Condenser R-Meter, the 120 Iometer, and the Integrator III all help to insure the application of a safe quantity of x-radiation to a patient.

Westinghouse Electric and Manufacturing Co. required one of the largest of the exhibit spaces to demonstrate their products. Of especial interest were the Photo-Fluorographic Camera, the Photo-timer constructed on the Morgan-Hodges principle, and a new series of dental units. A view box bank at 120° was a change from standard procedure.

Winthrop Chemical Co. exhibited Diodrast, Skiodan, and other pharmaceutical products used by the radiologist. Excellent instructive brochures on "Excretion Urography and Retrograde Pyelography" were available. Much interest was manifested in the new 70 per cent Diodrast solution, as used for angiography.

Wolf X-Ray Products, Inc.: An excellent showing of accessories of many types was made by this company. Protective gloves for use in fluoroscopy, opaque materials, filing equipment, and many other items were attractively displayed.

Year Book Publishers: The "Handbooks of Roentgen Diagnosis" and "Medical Physics" shared top interest at this exhibit. Unique in the literature, the Handbooks are actually x-ray atlases of convenient size, designed to provide the most direct possible presentation of the specific roentgen criteria pointing to correct diagnosis. "Medical Physics," edited by Dr. Otto Glasser, presents vital information in an understandable way.

The above notes are offered in a feeble attempt to tell those who failed to see the exhibits a little about what they missed, so that they will not fall into the same error at the next meeting.

With full knowledge that I have probably left unsaid the things which should have been said about many of the exhibits, and with apologies in advance for so doing, but with deep appreciation of the excellent exhibits and the co-operative exhibitors, this is respectfully submitted.

W. R. SCOTT, M.D.,
Chairman, Commercial Exhibits Committee

The Refresher Courses

Reservations prior to and registrations during the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America resulted in a grand total of 854 applicants for the Refresher Courses. Included in this group were registrants from 47 states and the District of Columbia, from Brazil, Canada, Chile, Cuba, Mexico, Peru, and Puerto Rico, truly a grand representation of both Americas. A large proportion of attendants at the Courses were members of one or both of the participating societies, many were members of the Armed Services, and many others attended as non-member, paying guests.

The excellent attendance at all the Courses speaks highly for this type of program and for the high caliber and exceptional talent of the members of the faculty. The three panels presented Sunday afternoon were faced with capacity crowds, 200 each for the course on Neurological Lesions and the Physics program, and 400 for Diseases of the Esophagus, Stomach and Duodenum. Sunday evening, 200 (capacity) attended the Panel on Carcinoma of the Breast, while a tremendous turnout of nearly 600 attended the Film Reading Session. All of these courses were well given and equally well received. We have heard nothing but praise for the program, thanks to all who participated and particularly to Drs. Fay Squire, T. J. Wachowski, R. S. Landauer, T. Leucutia, M. C. Sosman, Ross Golden, and E. P. Pendergrass for their part in the arrangements. The very excellent Film Reading Session would not have been possible without the University of Pennsylvania film projector. This instrument permitted film presentations that could be clearly seen throughout the Red Lacquer Room. The Committee is deeply indebted to Gene Pendergrass for its use.

A completely filled program of five courses was presented each morning, Monday through Friday, making, with the

Sunday Panels, a total of 28 courses. It would be impossible to say that any one course was better received than any other, since every audience was enthusiastic. The largest week-day attendance recorded was for the Gastro-Intestinal series, all of which were held in the Grand Ball Room. These were given as follows, Gallbladder and Pancreas, B. R. Kirklin, M.D., Duodenal Lesions, F. E. Templeton, M.D., Small Intestine, Ross Golden, M.D., Colon, Harry M. Weber, M.D., Acute Abdominal Disorders, Leo G. Rigler, M.D.

Chest pathology was well covered, with courses in the Pneumonias, with L. R. Sante, M.D., Lesser Circulation, W. Walter Wasson, M.D., Mediastinum, L. W. Paul, M.D., and Tuberculosis, C. C. Birkelo, M.D. A two-day course of exceptional merit—"Four Rare Diseases: Clinical, Pathological and Roentgenological Aspects (Acute Disseminated Lupus; Periarteritis Nodosa; Erythema Nodosum; Sarcoidosis)—was presented by M. C. Sosman, M.D., Howard Armstrong, M.D., and Orville Bailey, M.D.

Problems in Therapy and Physics were next in line; the faculty was well pleased and the attendants were most complimentary. These courses began with Practical Problems in Dosage Measurement by Edith H. Quimby, Sc.D., followed by Radium Physics, K. E. Corrigan, Ph.D.; Electronics in Radiology, Otto Glasser, Ph.D.; Roentgen Therapy for Infectious Processes, W. C. Popp, M.D., Biologic Reactions of Tissue to Radiation, Maj. M. Friedman, Radiotherapy of Hodgkin's Disease and Lymphosarcoma, Maurice Lenz, M.D., and Carcinoma of the Uterus with H. E. Schmitz, M.D., and J. F. Sheehan, M.D. The only regrets on these courses came about through the unavoidable overlapping of some of them, thus limiting selections to one a day.

The Roentgenology of the Urinary Tract, another two-day course, was well covered by E. P. Pendergrass, M.D., G. W.

Chamberlin, M.D., and P. Boland Hughes, M.D., a group of about 275 attending each session. In addition to radiologists, a number of genito-urinary surgeons registered for this course, and all were well pleased.

Courses on other subjects included Pelvimetry by Fred O. Coe, M.D.; Diaphragmatic Hiatus Hernia, Max Ritvo, M.D.; Roentgen Differentiation of Abdominal Tumors, Samuel Brown, M.D.; Low Back Pain, H. E. Potter, M.D.; Gynecography, R. A. Arens, M.D., and I. F. Stein, M.D., completing a well-rounded program.

The attendance at some of the courses was unusually large. This, however, was made necessary by the unexpectedly—but nevertheless welcome—large total regis-

tration for both the meeting and for the courses. On the fortunate side of the picture was the fact that the Palmer House was able to provide two such adequate rooms as the Red Lacquer Room and the Grand Ball Room, thus averting disappointment to the many applicants.

The success of this series of Refresher Courses is a source of real enjoyment to the members of the Committee and to both of the participating societies. May there be many, many more programs of this type and may they be even more successful.

B. R. KIRKLIN, M.D.

IRA H. LOCKWOOD, M.D.

LESTER A. SMITH, M.D.

WARREN W. FUREY, M.D., *Chairman*



ANNOUNCEMENTS AND BOOK REVIEWS

TECHNICIANS WANTED

The Editor has received from the Public Relations Office of the U. S. Army Recruiting Service a communication urging the enlistment of x-ray technicians in the Woman's Army Corps (WACS). The aim is to recruit 22,000 medical technicians of various types, including x-ray technicians, by Jan. 1, 1945.

"Qualifications include the following: American citizenship; 20-49 years of age, inclusive; satisfactory rating on the Army mental test; good health; no children under 14 years of age. Educational qualifications vary with the type of job; however, in every case the applicant must be at least a high school graduate.

"Women who are eligible for these positions will be sent to either Fort Oglethorpe, Georgia, or Fort Des Moines, Iowa, for six weeks' basic training. If they have had the technical training and necessary experience at the time of their enlistment, they will be assigned, upon completion of basic training, to medical jobs in Army hospitals either in this country or overseas. If they have not been technically trained, they may be sent to Army schools where they will be instructed for medical positions at Army expense.

"The Army conducts medical schools for women who are high school graduates even though they have had no medical training or experience. The following Army schools are now open: Dental Technician School (three months' course); X-ray Technician School (12 weeks' course; qualifications include high school courses in physics); Medical Laboratory Technician School (13 weeks' course); Medical Technician School (8 weeks' course); Surgical Technician School (8 weeks' course).

"Women who join the Army receive all the benefits accruing to men in the Service, including post-war security through the GI Bill of Rights.

"Thousands of injured men are coming back from the fronts, and the longer the war lasts, the more WACS will be needed to help doctors and nurses care for these soldiers who have given so much for an American victory."

ERRATUM

A regrettable error occurs in the paper by Capt. Peter Zanca and Lieut.-Col. Frederick K. Herpel—"A Statistical Analysis of 100,000 Examinations of the Chest by the Photoroentgen Method"—in the August issue of RADIOLOGY. The rejection rates for white and colored soldiers were unfortunately figured on an incorrect basis. The columns headed Rejection Rates per Thousand in Tables II, III, V, and VI (pages 123-126) should be corrected to read as follows:

TABLE II			TABLE III		
Col.	White	Total	Col.	White	Total
...	0.04	0.02	0.01	...	0.01
...	...	...	...	0.04	0.02
...	0.02	0.01	0.16	0.26	0.21
0.01	0.04	0.03	1.61	1.82	1.71
...	...	...	0.27	0.21	0.25
...	...	...	0.20	0.10	0.16
...	...	...	0.25	0.26	0.26
...	...	...	0.03	...	0.02
...	...	...	0.01	0.02	0.02
...	...	...	0.05	0.06	0.06
...	...	...	0.01	0.02	0.02
...	0.13	0.06	2.66	2.83	2.74
0.01	...	0.01	0.07	0.13	0.10
0.03	0.02	0.03	0.62	0.79	0.70
...	...	...	1.12	1.44	1.27
...	...	...	1.81	2.37	2.07
0.59	0.17	0.35	0.05	0.15	0.10
0.71	0.22	0.49	4.53	5.35	4.91
0.03	0.02	0.03			
0.11	...	0.06	TABLE VI		
0.05	0.08	0.07	Col.	White	Total
...	0.02	0.01	0.03	0.02	0.03
0.01	...	0.01	...	...	...
1.50	0.79	1.18	0.11	0.15	0.13
TABLE V			0.66	0.24	0.47
Col.	White	Total	0.84	0.30	0.60
...	...	...	2.62	0.68	1.74
0.03	0.02	0.03	1.13	0.17	0.70
0.03	0.06	0.05	0.22	0.04	0.14
0.07	...	0.04	0.01	...	0.01
0.49	0.70	0.59	0.03	0.02	0.03
0.12	0.06	0.10	0.01	...	0.01
0.78	0.30	0.57	0.01	...	0.01
0.16	0.08	0.13	0.01	...	0.01
0.07	0.04	0.06	5.72	1.64	3.87
0.01	0.02	0.02			
0.01	0.02	0.02			
0.55	0.41	0.49			
0.34	0.15	0.26			
0.09	0.04	0.07			
0.07	0.02	0.05			
0.14	0.15	0.26			
0.01	...	0.01			
0.77	0.70	0.74			
0.11	0.04	0.08			
0.03	...	0.02			
...	0.02	0.01			
0.07	0.04	0.06			
4.05	2.94	3.55			

In Table IV, the last line, showing the rejection rate per thousand, should be corrected to read, in Column 1 (Active), Col. 2.66, Wh. 2.83, Total 2.74; in Column 2 (Arrested), Col. 1.81, Wh. 2.37, Total 2.07; in Column 3 (Questionable Activity), Col.

0.05, Wh. 0.15, Total 0.10; in Column 4 (Total), Col. 4.53, Wh. 5.35, Total 4.91.

The authors greatly regret the necessity of these corrections.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

METASTASES, MEDICAL AND SURGICAL. By MALFORD W. THEWLIS, M.D., Attending Specialist in General Medicine, United States Public Health Hospitals, New York City; Attending Physician, South County Hospital, Wakefield, Rhode Island; Special Consultant, Rhode Island Department Public Health; Author Care of the Aged (Geriatrics), Preclinical Medicine. Foreword by HUBERT A. ROYSTER, A.B., M.D., F.A.C.S., Honorary Chief Surgical Service, Rex Hospital; Chief-of-Staff, St. Agnes Hospital; Consulting Surgeon, Dix Hill State Hospital; Fellow American Board of Surgery, Raleigh. A volume of 230 pages, with 13 illustrations. Published by the Charlotte Medical Press, Charlotte, N. C., 1944. Price \$5.00.

THE MEDICAL ANNUAL 1944. A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX. Editors: Sir HENRY TIDY, K.B.E., M.A., M.D. (Oxon.), F.R.C.P., and A. RENDLE SHORT, M.D., B.S., B.Sc., F.R.C.S. Published by John Wright & Sons Ltd., Bristol, and Simpkin Marshall (1941) Ltd., London.

Book Reviews

RADIATION AND CLIMATIC THERAPY OF CHRONIC PULMONARY DISEASES, WITH SPECIAL REFERENCE TO NATURAL AND ARTIFICIAL HELIOTHERAPY, X-RAY THERAPY, AND CLIMATIC THERAPY OF CHRONIC PULMONARY DISEASES AND ALL FORMS OF TUBERCULOSIS. Edited by EDGAR MAYER, M.D., F.A.C.P., F.A.C.C.P., Assistant Professor of Clinical Medicine, Cornell University Medical College, New York City; Attending Physician New York and Memorial Hospitals; Special Pulmonary Consultant, New York State Department of Labor; Formerly Member Faculty Trudeau School for Tuberculosis; Director (ex urbe) Northwoods and Will Rogers Tuberculosis Sanatoria, Saranac Lake, New York; Consultant on Tuberculosis to the Government of Cuba; Board Member of the Finlay Institute of the Americas. With the collaboration of the fol-

lowing contributors: Louis Beardslee Baldwin, Irvin I. Balensweig, Alfred Lee Briskman, William Chang, Anthony C. Cipollaro, William W. Coblentz, Lloyd F. Craver, Martin Dworkin, Earl C. Elkins, John N. Hayes, Ira I. Kaplan, H. Haig Kasabach, Eugene Kisch, Frank H. Krusen, Henry Laurens, Maurice Lenz, Horace LoGrasso, Harriet C. McIntosh, Clarence A. Mills, Leroy S. Peters, Homer L. Sampson, Stanley L. Wang. A volume of 393 pages, with 46 illustrations. Published by The Williams and Wilkins Company, Baltimore, 1944. Price \$5.00.

This timely and excellent monograph covers the whole field of climatic and radiation therapy of chest diseases, with special stress on pulmonary and extrapulmonary tuberculosis. Chapters are included on the physics and physiologic action of light, and the various sources of artificial light therapy are discussed in detail with technic and dosage as applied to tuberculous involvement of the different organs of the body. In the chapters on solar radiation and climatotherapy, the climatic conditions of the better known tuberculosis resorts throughout the country are presented. These data should be helpful in selecting a resort for the patient.

The x-ray therapy of chronic non-tuberculous mediastinal and pulmonary disease is also discussed. While this form of therapy in most chest diseases is largely on an empirical basis, unquestionably beneficial results have at times been obtained. Pressure symptoms resulting from enlarged mediastinal lymph nodes generally respond to radiation therapy. For each disease, technic and dosage are given.

In view of the definite increase in the incidence of cancer of the lung, the essay on x-ray therapy for intrathoracic tumors is particularly timely. Emphasis is placed on the importance of histologic diagnosis before instituting either operative or x-ray therapy. If this is established, the choice between surgery and irradiation is simplified.

As frequently happens, the medical pendulum has swung to extremes in the use of climatotherapy. It is not so long since climate was regarded as the most important factor in the treatment of pulmonary tuberculosis. The tendency today is to attribute little if any value to it. This monograph stresses the therapeutic value of climate and light in properly selected cases. In pulmonary tuberculosis, for instance, the importance of a qualitative diagnosis is highly emphasized. Exudative or caseous lesions are likely to break down under light therapy. The fibrotic or productive lesions usually respond favorably. The selection of light therapy is always an individualized procedure, requiring time and effort on the part of the physician to determine dosage and the kind and source of light. Precise information is given on how to determine skin and constitutional reactions and how these factors influence dosage and choice of therapy.

The book will be found valuable for reference.

Sooner or later, a physician is consulted as to the advisability of change of climate or use of heliotherapy. Exact information on these points is available in this monograph. Finally, Mayer's résumé on climatic, x-ray, and light therapy of chronic pulmonary diseases and all forms of tuberculosis will be found decidedly helpful in assessing these factors in relation to the person and his disease.

THE MODERN MANAGEMENT OF COLITIS. By J. ARNOLD BARGEN, M.D., M.S., F.A.C.P., Chief of the Section on Intestinal Diseases, Division of Medicine, Mayo Clinic; Associate Professor of Medicine, Mayo Foundation, Rochester, Minnesota; Secretary, American Gastroenterological Association; Vice-Chairman, Section on Gastroenterology and Proctology, American Medical Association. A volume of 322 pages, with 148 figures. Published by Charles C Thomas, Springfield, Ill. Price \$7.00.

This book reflects the enormous experience of the author in the diagnosis and treatment of ulcerative colitis. At the outset he distinguishes between so-called "mucous colitis," which "actually should never masquerade under the name of 'colitis,'" and true ulcerative colitis. He includes an excellent chapter on the former condition under the heading "The Irritable Colon," with appropriate emphasis on the treatment of the emotionally unstable patient and a timely consideration of the use of laxatives, enemas, and colonic irrigations.

Ulcerative colitis is helpfully classified under nine headings: (1) thrombo-ulcerative colitis of streptococcal origin; (2) regional (segmental) ulcerative colitis; (3) a type not distinguishable pathologically from the second type but tending to involve the rectum, with or without involvement of segments higher in the colon; (4) tuberculous ulcerative colitis; (5) amebic ulcerative colitis; (6) colitis associated with dietary deficiencies; (7) a type due to the virus of venereal lymphogranuloma; (8) a type associated with allergy; (9) the type occurring as a late phase of bacillary dysentery. To each of these a chapter is devoted, with a discussion of the causative factors, diagnosis, and treatment, including surgical indications.

A final chapter enumerates the conditions to be differentiated from colitis, including polyposis, cancer, regional enteritis, diverticulosis and diverticulitis, food poisoning, parasitic diseases, appendicitis, deficiency diseases, volvulus and intussusception, benign stricture, and gallbladder disease.

Appropriate cases are presented to demonstrate the points made in the author's discussion and numerous illustrations show the pathologic and roentgen findings.

X-RAY EXAMINATION OF THE STOMACH. A DESCRIPTION OF THE ROENTGENOLOGIC ANATOMY, PHYSIOLOGY, AND PATHOLOGY OF THE ESOPHAGUS, STOMACH, AND DUODENUM. By FREDERIC E. TEMPLETON, M.D., Head of the Department of Roentgenology, The Cleveland Clinic. A volume of 516 pages, with 287 reproductions of x-ray plates. Published by the University of Chicago Press, Chicago, Ill. Price \$10.00.

Doctor Templeton's new volume dealing with the roentgen examination of the upper digestive tract will be a valuable addition to the library of every roentgenologist. As in most modern radiological textbooks, considerable emphasis is placed on anatomical, physiological, and clinical features. Most of the diseases that involve the upper digestive tract are described in detail, and in each instance the attempt is made to correlate the anatomic and pathologic changes with the diagnostic evidence furnished by the screen and film. The discussion of the various lesions involving the esophagus, stomach, and duodenum is preceded by chapters on the normal findings in these organs and the basic principles of interpretation.

The book is of special value because of its presentation of the more recent developments in gastric roentgenology, such as mucosal studies and the filming fluoroscope. A full description is given of the various steps of the fluoroscopic examination, including relief technic and the use of compression in demonstrating the mucosal pattern. A chapter is devoted to the filming fluoroscope.

The book is amply illustrated and provided with an adequate index.



RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse 2, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago 11, Ill.

Section on Radiology, American Medical Association.—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Earl R. Miller, M.D., University of California Hospital, San Francisco, Calif.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Meets annually during meeting of California Medical Association.

San Diego Roentgen Society.—Secretary, Henry L. Jaffe, M.D., Naval Hospital, Balboa Park, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Martha Mottram, M.D., Suite 1789, 450 Sutter St., San Francisco. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital, from January to June; at Lane Hall, Stanford University Hospital, July to December.

COLORADO

Denver Radiological Club.—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, Charles M. Gray, 306 Citizens Bldg., Tampa 2.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 7144 Jeffery Ave., Chicago 49. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St., Baltimore 1. Meets third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, A. J. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, E. W. Spinzig, M.D., 2646 Potomac St. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha 2. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—Secretary-Treasurer, George Levne, M.D., Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. R. Brindle, M.D., 501 Grand Ave., Asbury Park. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave., Brooklyn 26. Meets fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month. October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Ramsay Spillman, M.D., 115 E. 61st St., New York 21, N. Y.

Rochester Roentgen-ray Society.—Secretary, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—Secretary-Treasurer, Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia 4. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Lester M. J. Freedman, M.D., 4800 Friendship Ave., Pittsburgh 24, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—Secretary, A. M. Popma, M.D., 220 North First St. Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison 6, Wis. Meets every Thursday from 4 to 5 P.M., Room 301; Service Memorial Institute

CANADA

La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Pneumoencephalography in the Study of the Sequelae of Head Injuries. Frank H. Mayfield and Joseph C. Bell. *South. M. J.* 37: 142-149, March 1944.

This paper deals with the fundamental principles of pneumo-encephalography. It sets forth a simple technical procedure and describes, with several illustrations, a few of the diagnostic roentgenologic criteria of post-traumatic encephalopathy.

The patient is prepared with pentobarbital sodium and morphine sedation and brought for examination with an empty stomach. A special cassette-holding device, attached to the tube housing, facilitates the procedure by maintaining a fixed distance measurement and eliminates the hazard of exposing the technician. With a well co-ordinated team, the procedure can easily be completed in less than one-half hour. The authors believe that this examination should *not* be done in the presence of increased intracranial pressure.

Failure of the ventricles to fill is not a reliable indication of disease, since a second injection will often result in a normal outline. Enlargement of cerebral fissures is of little diagnostic value unless associated with ventricular deformity or displacement. Symmetrical enlargement of the ventricles is, of course, strongly suggestive of an obstructive lesion which may require surgical treatment. A similar picture is produced by diffuse cerebral atrophy. Unilateral hydrocephalus without displacement generally means local cerebral atrophy on the affected side. If the ventricular system is shifted toward the dilated ventricle, the condition is due to a meningocerebral scar or great loss of cerebral substance, as in compound injuries with infection.

Porencephaly may be found in traumatic epilepsy or post-concussion states. This term is used to cover all cystic defects communicating with the ventricular system, congenital or acquired. Enlargement of the third ventricle alone is generally to be disregarded. Gas over the cerebellum is indicative of cerebellar atrophy but this condition is extremely rare except as a part of a generalized atrophy. The cisterna magna varies considerably in size in normal subjects and such variations must not be interpreted too closely.

As regards therapeutic benefits from encephalography, the authors are of the opinion that occasionally temporary symptomatic relief is obtained but that the procedure is not justified for this purpose.

MAX MASS, M.D.

Osteochondroma of the Base of the Skull. Lester S. King and James Butcher. *Arch. Path.* 37: 282-285, April 1944.

The case of osteochondroma of the base of the skull here presented is unusual in that the neurologic symptoms were not displayed until terminally.

A 26-year-old man with a history of intermittent peptic ulcer for five years was admitted to the hospital for treatment of gastric distress. Roentgen studies of the gastro-intestinal tract showed a non-obstructive duodenal ulcer. The patient complained, also, of a vague headache. Routine roentgen examination of the sinuses incidentally revealed a large irregular mass, extending upward from the right lateral margin of the sella turcica. In spite of the location of the tumor in

the region of the chiasm, the fundi, visual fields, and the eye movements were entirely normal. About four weeks after the onset of the headache, the patient suddenly collapsed and died with signs of cerebral (subarachnoid) hemorrhage. At autopsy, the mass apparent on the roentgenogram proved to be an osteochondroma of the sphenoid bone.

THE CHEST

Pulmonary Conditions in Rejectees: Analysis of 2,270 Selectees Rejected for Pulmonary Conditions in the Induction Centres of Massachusetts. David Zacks and Robert W. Hyde. *Am. Rev. Tuberc.* 49: 332-342, April 1944.

An analysis is presented of 2,270 men rejected or deferred for military service because of pulmonary conditions discovered on miniature x-ray films. Of these, 1,385, or 66 per cent, had a clinical follow-up study after the original x-ray examination. The majority of the lesions found were tuberculous, either of the reinfection or primary type. The non-tuberculous lesions were largely bronchiectasis, silicosis, sarcoidosis, non-tuberculous fibrosis, and pulmonary abscess. Three hundred and ninety-five men were listed as "pulmonary suspects," and 160 of these were successfully followed and studied. It was found that 86, or 54 per cent of this number, had pulmonary tuberculosis, while the others showed normal chests, healed primary tuberculosis, or non-tuberculous pulmonary disease.

In the group in whom pulmonary tuberculosis was diagnosed on the original study, follow-up examinations revealed an error of commission of 5 per cent. Also, the differentiation between a primary and a reinfection type of lesion could not always be made with certainty when the lesion was early and active. At this stage it was difficult to determine whether or not the lesion was tuberculous, since an acute or subacute atypical pneumonia may present a similar appearance. It is recommended that these patients should be put to bed and then observed monthly with x-ray studies. The acute non-tuberculous lesion will usually clear within three months. Lesions persisting longer than three months, or showing spread, should be regarded as tuberculous.

Sixty-six per cent of the cases of pulmonary tuberculosis discovered were previously unknown, while 34 per cent had been reported to the Board of Health. According to the stage of disease, there were 67 per cent minimal lesions, 23 per cent moderately advanced, and 10 per cent advanced. The order of this distribution by stages is the reverse of that usually found in sanatorium admissions.

L. W. PAUL, M.D.

Primary Atypical Pneumonia, Etiology Unknown. John H. Dingle *et al.* *Am. J. Hyg.* 39: 67-128, January; 197-268, March; 269-336, May, 1944.

This is a full report of a study of primary atypical pneumonia made at Camp Claiborne, La., previously reported more briefly by the same writers in *War Medicine* (3: 223-248, 1943) and abstracted in *Radiology* (42: 407, April 1944). Appended to this presentation are tables of the clinical, roentgenological,

and laboratory findings, accounts of serologic studies, bronchoscopic examinations, and complement-fixation tests for Q fever, and an autopsy report of one case.

Diagnosis and Treatment of Bronchiogenic Cysts of the Mediastinum and Lung. Robert K. Brown and Laurence L. Robbins. *J. Thoracic Surg.* 13: 84-105, April 1944.

This paper is a review of 21 bronchiogenic cysts of the lung and mediastinum. Twelve were in the mediastinum and 9 in the lung. The symptoms depend on the location and size of the cysts and the presence or absence of infection. Pain is the most common complaint, followed by cough, expectoration, hemoptysis, and dysphagia. The preoperative diagnosis depends largely on roentgen examination. The mediastinal cysts may be anywhere in the mediastinum and are smooth and round, often attached to the trachea or main bronchi. Unless the cyst communicates with the bronchus and shows a fluid level, a malignant tumor cannot be definitely excluded, making surgery almost a necessity. Lung cysts are also smooth and round and are most often in the lower part of the chest. Surgical removal is the treatment of choice.

Case histories are presented for all 21 patients, and representative roentgenograms are reproduced.

HAROLD O. PETERSON, M.D.

Intrathoracic Neurogenic Tumors. Edward M. Kent, Brian Blades, Anibal Roberto Valle, and Evarts A. Graham. *J. Thoracic Surg.* 13: 116-161, April 1944.

The authors studied 18 proved and 3 presumptive cases of intrathoracic neurogenic tumors. Abstracts of all these cases are presented together with roentgenograms, photographs of the gross specimens, and photomicrographs for many of them. In addition, 105 cases from the literature are listed. Forty-one per cent of the authors' series and 37 per cent of the reported cases were considered to be malignant, in spite of the common belief that these tumors are benign. The most common tumor in the posterior mediastinum is one of neurogenic origin. Among 101 reported cases, there were only 2 examples in the anterior mediastinum.

Symptoms may be absent or there may be pain, dyspnea, cough, stridor, and hoarseness. The tumors are usually single, rounded and smooth in outline. There may be rib erosion. A lobulated appearance suggests rapid growth. A pleural effusion does not definitely indicate malignancy. Radiation therapy is of no value, the only effective treatment being surgical removal.

HAROLD O. PETERSON, M.D.

Carcinoma of the Lung in a Ten Year Old Negro Boy. Béla Halpert and Peter E. Russo. *Arch. Path.* 37: 290-293, April 1944.

According to Oehsner and DeBailey (*Arch. Surg.* 42: 209, 1941) carcinoma of the lung metastasizes most frequently to the regional lymph nodes, next most frequently to the liver, third to the skeleton, and fourth to the adrenal glands. In the case reported here, in a ten-year-old Negro boy, skeletal involvement was the dominant feature and there was no metastasis to either the liver or the adrenals. Skeletal lesions produced by pulmonary cancer are usually osteolytic, destroying bony structure and pattern. In the present case the growth seemed to be osteoplastic, filling the marrow

spaces, which were separated by broad and intact lamellas, and broadening the periosteal zones. Death occurred about eight months after the onset of symptoms.

Roentgenographic Demonstration by Diodrast of the Pleural Walls in Open Empyema. Joseph Gordon. *J. Thoracic Surg.* 13: 162-165, April 1944.

Because of the difficulty of completely outlining an empyema pocket by means of iodized oils, the authors have used either diodrast in a 35 per cent solution or skiodan in acaia. This material is sprayed into the empyema cavity with the aid of a nebulizer connected to a small air pump. About 10 c.c. of solution is used. The procedure so far has been employed only in open pleural cavities. The spray coats the walls, which then show up clearly on the roentgenogram.

HAROLD O. PETERSON, M.D.

Encapsulated Pleural Effusion Due to Heart Failure: Report of Two Cases. Abraham H. Russakoff and Tobias Weinberg. *New England J. Med.* 230: 379-381, March 30, 1944.

Less than 50 cases of encapsulated pleural effusion due to heart failure have been reported in the literature. The first case was found and proved at autopsy in 1912. This condition has been considered rather rare, but in a series of 368 cases of heart failure, 35 per cent were found to have x-ray evidence of simple hydrothorax, and among these were 11, or 8 per cent, with interlobar effusions.

Roentgenologically effusions in the interlobar spaces may appear round, ovoid, band- or wedge-shaped. They are best demonstrated by both postero-anterior and lateral views of the chest.

According to Stein and Schwedel (*Am. Heart J.* 10: 230, 1934), in the hydrothorax of cardiac decompensation some of the fluid may seep into the interlobar fissure and remain after obliteration of the pleural space has occurred following organization of fibrin.

Two case reports are presented with roentgenograms demonstrating the encapsulated pleural effusion.

JOHN B. MCANENY, M.D.

THE DIGESTIVE SYSTEM

Roentgenological Appearance of the Gastrointestinal Tract in Scleroderma. Clayton H. Hale and Richard Schatzki. *Am. J. Roentgenol.* 51: 407-420, April 1944.

The roentgen appearance of the gastro-intestinal tract in 22 patients with scleroderma is described. In 7 of the group, examination of the esophagus was made because of dysphagia. The remaining 15 had no definite symptoms referable to the esophagus and were examined routinely for the purpose of this study. Five of the 7 patients complaining of dysphagia, and 8 of those who were without subjective symptoms showed roentgenologic abnormalities.

While some variation occurred, the appearance in the esophagus followed a certain pattern. There was delay in the passage of the barium from the pharynx to the stomach, and in some cases complete emptying of the esophagus was delayed for as much as half an hour. As a rule, the barium passed into the stomach as a slow but fairly constant trickle. In several patients the lower end of the esophagus appeared slightly

exercise, in certain positions, or on coughing or sneezing, are important evidence when present.

The objective findings can be divided into back findings and radicular findings. Usually the patient assumes a protective posture, but pain in the back will occur on quick, unprotected motion. Forward bending is limited to 50 or 75 per cent of normal, while hyperextension is limited variably and lateral bending moderately. Not infrequently the patient may notice a localized area of paresthesia below the knee, taking the form of tingling, burning, electric shock, or a feeling of thickness of the skin. Compression of the fifth lumbar root by the fourth lumbar disk may produce either hypesthesia or paresthesia of the great toe and anterolateral leg. A paresis of the extensors of the great toe or the tibialis anterior may be noted when the muscles of the leg are tested under weight-bearing. Rarely the ankle jerk may be diminished. Herniation of the lumbosacral disk with pressure on the first sacral root may produce paresthesia or hypesthesia of the lateral foot and posterolateral leg. The ankle jerk is usually diminished or absent, while there may be a slight paresis of the Achilles muscle group.

Because of the increasing accuracy of clinical examination, contrast myelography is used much less frequently than formerly. In the group of patients with less conclusive findings, however, this procedure is required to prove or disprove a disk lesion. Pantopaque is favored as a contrast material because of its low viscosity, which facilitates examination of the entire spine and demonstration of small irregularities, and the ease of aspiration following completion of the procedure. Lipiodol is more difficult to aspirate and is usually less completely removed from the spinal canal. With air the entire spine is not examined, the contrast is poor, and small irregularities are not demonstrated. With thorotrast, severe after effects are occasionally noted and the procedure for drainage is complicated.

The puncture is made in the mid-line at the site of the suspected lesion, and the pantopaque (3 c.c.) is slowly injected after a free flow of cerebrospinal fluid is obtained. The stylet is then replaced, and the patient is examined fluoroscopically on the tilt table in the prone position. Numerous spot films are made with the pantopaque balanced opposite each of the lower two intervertebral disks and with the sacral sac completely filled by having the patient stand upright. After fluoroscopy is completed and the spot-films checked for satisfactory exposure, the pantopaque may be aspirated by bringing the table to such an angle that the point of the needle is in the center of the column. Aspiration will either be possible with a minimal force, or completely impossible.

Partial hemilaminectomy is regarded as the routine treatment. Operation in the sitting position is preferred, as flexion of the lumbar spine and weight-bearing bring out the herniated cartilage more prominently.

The satisfactory results obtained have been adequate repayment for the pains taken in accurate diagnosis.

ELLWOOD W. GODFREY, M.D.

Acute Suppurative Arthritis of the Hip in Childhood. Peter E. Russo. *Am. J. Roentgenol.* 51: 447-454, April 1944.

Acute suppurative arthritis of the hip in childhood is discussed from the standpoint of (1) anatomical factors, (2) types of arthritis, (3) bacterial characteristics, and

(4) roentgenologic aspects. This is a relatively frequent disease of childhood and early adolescence. In the author's series of 40 cases in children under fifteen there were 22 males and 18 females; 27 of the patients were from ten to fourteen years old.

In the primary type of acute suppurative arthritis, the infection attacks the synovial or perisynovial structures. In the secondary type the location is primarily intraosseous and the joint is affected by spread or extension of the bone infection. The primary type is in most instances of streptococcal origin and usually subsides within five weeks. The affected hip in many cases regains its normal range of motion. The secondary type is usually due to staphylococcal infection and tends to run a long drawn out course. Draining sinuses may take months or years to heal. Range of motion is in most cases seriously impaired, and ankylosis and deformities of the hip result in the majority of cases.

Roentgenograms are invaluable in detecting the presence of arthritic lesions of the hip, in following the different phases, and in evaluating the end-result. The early stages are manifested by narrowing of the joint space, which occurs as early as five days after onset of the disease. Another early roentgen finding, described by Chont (*Radiology* 38: 708, 1942), consists in a lateral and upward subluxation of the femoral head. This differs from the findings encountered in congenital dislocation by the associated soft-tissue swelling of the pelvic girdle and the ground-glass appearance of the bone, which is usually of normal and uniform density in the congenital cases. In early hip infection, the epiphyses of the femoral heads are equally well developed but differ in density. When the disease is primarily intraosseous, the bone lesions may not be identified on the roentgen film for ten or fifteen days after the onset. Evidences of osteomyelitis then make their appearance.

The primary type of arthritis occurs mostly in children under two years of age. The secondary type is much more common, the most frequent sites of the intraosseous lesion being the femoral neck, the ilium, the ischium, and pubis, in the order mentioned.

L. W. PAUL, M.D.

THE GENITO-URINARY TRACT

Incidental Findings in Urograms Concerning the Uterus. J. T. Marr and U. V. Portmann. *Am. J. Roentgenol.* 51: 426-433, April 1944.

The shadow of the dye-filled urinary bladder often varies in shape in men and women. In the former the upper surface usually is convex, while in females it frequently is concave. This observation suggested that the concave impression was due to the uterus. To confirm this hypothesis 50 urograms of men were studied to determine the usual shape of their bladders. The majority were convex across the fundus but a few were flattened or slightly irregular. Five hundred unselected urograms of women were then examined to study the impression of the uterus on the bladder, and the findings were correlated with case histories and pelvic examinations.

It was found that the size, shape, and position of the uterus and the presence of pathological conditions in the pelvis could often be determined by the contour of the impression on the bladder seen in the urogram. Absence of a uterine impression on the bladder may be explained on the basis of (a) too small a uterus, (b)

retroflexion or retroversion of the uterus, (c) absence of the uterus, as a result of hysterectomy, (d) atrophy of the uterus after a natural or induced menopause, (e) overdistention of the bladder with opaque medium. When the concave impression on the bladder is visible, its width is a good indication of the width of the uterine fundus. Occasionally, the fundus can be seen even in plain roentgenograms as a soft-tissue shadow. All patients had urograms made at five-, fifteen-, thirty-, and sixty-minute intervals, the last giving the most information because the bladder usually contained more opaque medium and uterine impressions were deeper. It is probable that urograms made in the up-

right position would give more accurate information since the uterus would fall more heavily upon the bladder. In certain cases cystograms may be indicated for the specific purpose of studying uterine impression and roentgenoscopy while the bladder is filling might be of value.

The information obtained concerning the size and shape of the uterus may be of clinical importance, since manual pelvic examinations, even by physicians with experience, do not always agree as to uterine size, and in some patients it is difficult to do pelvic examinations and obtain even a rough estimate of the size or position of the uterus.

L. W. PAUL, M.D.

RADIOTHERAPY

MALIGNANT NEOPLASMS

Treatment of Cancer of the Larynx by Roentgen Irradiation: Report of Five Year End-Results. John V. Blady and W. Edward Chamberlain. *Am. J. Roentgenol.* 51: 481-495, April 1944.

In an analysis and five-year-survival study of 36 cases of cancer of the larynx treated during the years 1931 to 1937 in the Department of Roentgenology and Radium Therapy of Temple University Hospital (Philadelphia), 23 (64 per cent) were classed as intrinsic and 13 (36 per cent) as extrinsic. Metastases were infrequent in cancer of the intrinsic larynx; only 4 of the 23 patients presented metastases on admission, while in 2 metastases developed later in the course of the disease. In the extrinsic group, metastasis is more common; 6 of the 13 patients showed metastatic lesions at the time of admission. None of the patients having proved cervical metastases on admission survived. For the 17 patients with intrinsic cancer without metastasis at any time during the course of the disease, the five-year survival rate was 71 per cent. In the comparable group of extrinsic cases, numbering 7, there were 3 five-year survivals (43 per cent).

The daily dose of radiation was 125 r, measured in air, delivered through 10 × 10-cm. fields to each side of the neck at a rate of 5 to 6 r per minute. A total of at least 3,000 r was delivered to each skin field, requiring a minimum of twenty-four consecutive days for the completion of treatment. The physical factors were 180 kv. constant potential, 5 ma., 50 cm. target-skin distance, and 2 mm. copper plus 1 mm. aluminum filtration. It was found that the upright position was more comfortable for the patient and allowed more accurate centering, and after 1935 this position was used, the head being supported by a head rest fastened to the back of an ordinary chair. Also during the latter part of the period, the use of large rectangular fields was discontinued and interchangeable circular metal cones, varying in diameter from 5.5 to 10 cm., were employed. With these smaller fields the cutaneous reaction may be as severe as with the large fields, but the area and volume of tissue involved are much less; thus, larger tumor doses may be administered without producing severe local and generalized constitutional reactions. Because the use of small cones requires accurate localization of the radiation beam, the anatomic location of the lesion should be carefully centered on the skin of the neck after thorough localization of the lesion by direct vision or palpation. The accuracy of the centering may be checked by exposing a roentgenogram, using the therapy machine for this purpose.

The various reactions and complications of treatment encountered in this series are discussed in some detail. Methods for relieving the discomfort accompanying the unavoidable skin and mucous membrane reaction are described.

L. W. PAUL, M.D.

Roentgen Rays in the Treatment of Carcinoma of the Bronchus, with an Analysis of 69 Cases Treated in the State of Wisconsin General Hospital from 1933 to 1943. Ernst A. Pohle and Evelyn L. Siris. *J. Thoracic Surg.* 13: 67-83, April 1944.

Sixty-nine cases of carcinoma of the lung treated by roentgen rays are reviewed. Of these, 42 were far advanced, with metastases before the diagnosis was made. For the more favorable cases the treatment factors were as follows: 400 kv.; 5 ma.; 50 cm. distance; half-value layer in Cu, 2.4 mm.; 200 r daily to each of two portals, 10 × 10 cm. to 15 × 15 cm., anteriorly and posteriorly; total dose in air 2,400 to 3,000 r to each portal, or in the average 21-cm. chest a tumor dose of 2,500 r, which the authors indicate is a carcinocidal dose. Six weeks or so later a second series of 1,500-2,000 r in air is given to each of two portals anteriorly and posteriorly. Further treatment is then given in small amounts, not less than three months apart. The authors advise against large fields and against treating infected areas. In advanced cases, in debilitated patients, 800-1,600 r is given to each of two portals to alleviate symptoms. In cases with widespread metastases 1,200-1,600 r in air is given to two opposing fields for relief of pain.

One patient survived six and one-half years after diagnosis; only 5 lived over two years. The authors conclude that the greatest value of radiation therapy in patients with carcinoma of the bronchus lies in its palliative effect. Only occasionally can a five-year survival be achieved.

HAROLD O. PETERSON, M.D.

TECHNIC, DOSAGE, APPARATUS

Use of Wedge Filters in Deep X-Ray Therapy. F. Ellis and H. Miller. *Brit. J. Radiol.* 17: 90-94, March 1944.

For the treatment of tumors near the surface, such as one side of the floor of the mouth, the ethmoid region, the middle ear, the vulva, the anus, and the brain, the use of wedge-shaped filters is advocated. Wood or brass is used in the filter. The field produced has an asymmetrical distribution of radiation. Depending on the location, the wedge-filtered fields are

used at right angles to each other or directly opposite. They may sometimes be advantageously combined with a conventionally filtered field. One particular advantage is that whatever the combination the depth dose falls off rapidly at the edge of the field. Typical depth distribution curves are given.

SYDNEY J. HAWLEY, M.D.

A Dosage System for Linear Gamma-Ray Sources. D. E. A. Jones. Brit. J. Radiol. 17: 46-47, February 1944.

For treating lesions like carcinoma of the rectum, uterus, etc., where the area treated approximates a cylindrical surface, an approximately uniform dose may be obtained by axially placed spaced radium. Graphs are presented for determining the amount of spacing of the radium source for various sizes of cylinders.

SYDNEY J. HAWLEY, M.D.

Time Intensity Factor in X-Ray Irradiation. Pt. I. The Influence of the Overall Time. Edith Paterson. Brit. J. Radiol. 17: 26-30, January 1944.

Experiments *in vitro* on fibroblasts of the chick embryo, varying the over-all time but keeping the total dose constant, show that there is no significant difference in the radiation effect in short over-all times. Increasing the over-all time to four days decreases the survival rate of the fibroblasts, but there is no significant difference produced by various spacings of the sessions. Increasing the over-all time to twenty-one days, with eleven sessions, was found to produce the greatest effect.

These experiments indicate that prolonging the over-all time with suitable splitting offers advantages over short-time irradiation. The survival times are more homogeneous and the lethal effect is enhanced.

SYDNEY J. HAWLEY, M.D.

EXPERIMENTAL STUDIES

Retention of Radioactive Phosphorus when Administered in Different Chemical Forms. Shields Warren and Russell F. Cowing. Cancer Research 4: 113-115, February 1944.

The efficacy of radioactive phosphorus as a therapeutic agent in some types of leukemia and allied diseases has been demonstrated. The form in which radioactive phosphorus has thus far been administered is the dibasic sodium phosphate (Na_2HPO_4). Since this is not readily prepared chemically, since the half life of radioactive phosphorus is limited (14.3 days), and since the services of skilled chemists are difficult to obtain at the present time, it has become of practical importance to determine whether or not more easily prepared forms containing the phosphate acid radical are satisfactory for therapeutic use. Radioactive phosphorus in the form of magnesium ammonium phosphate and of phosphoric acid was used for this study. No reactions were encountered with the intravenous administration of these two compounds.

The amounts of radioactive phosphorus administered ranged from 130 to 3,850 μc . in the case of Na_2HPO_4 , from 1,100 to 3,900 μc . in the case of $\text{MgNH}_4\text{P}_2\text{O}_7$, and from 1,000 to 4,000 μc . in the case of $\text{H}_3\text{P}_2\text{O}_7$. All measurements represent microcurie equivalents and were made with a modified Geiger counter checked against the Lauritsen type electroscope as modified by Hudson and Cowing.

The retention of the radioactive phosphorus was practically identical regardless of which of the three compounds was used. In the case of dibasic sodium phosphate and in the case of phosphoric acid, one instance each of poor retention was encountered, in the former unexplained and in the latter due to extensive intestinal hemorrhage. The therapeutic effect of these

three compounds in the treatment of leukemia has been indistinguishable.

If it is necessary to conserve time in the preparation of radioactive phosphorus for therapeutic use, $\text{H}_3\text{P}_2\text{O}_7$ or $\text{MgNH}_4\text{P}_2\text{O}_7$ may be substituted for Na_2HPO_4 as the vehicle of administration.

Comparative Studies on the Radiosensitivity of Normal and Malignant Cells in Culture. II. The Delayed Lethal Effect. L. Doljanski, G. Goldhaber, and L. Halberstaedter. III. Further Studies on the Inhibitory Effect of X-Rays on Cell Outgrowth. G. Goldhaber, L. Doljanski, and L. Halberstaedter. Cancer Research 4: 106-109, 110-112, February 1944.

In a previous communication (Cancer Research 2: 28, 1942. Abst. in Radiology 39: 252, 1942) the authors showed that the "immediate lethal dose" of x-rays for rat sarcoma cells *in vitro* is the same as that for normal rat fibroblasts. Doses of 200,000 r uniformly and immediately check all cell outwandering in cultures of normal as well as neoplastic cells. Further studies on radiosensitivity of normal and malignant cells showed that a dose of 2,000 r rendered prolonged cultivation of the irradiated cultures uniformly impossible, while the effect of smaller doses was inconstant. On this basis the minimal delayed lethal dose of x-rays for rat sarcoma cells cultivated *in vitro* is given as 2,000 r. This is less than half the equivalent dose for normal chick fibroblasts, whose proliferative capacity is irreversibly checked only after irradiation with 5,000 r. The minimum dose of x-rays that causes appreciable inhibition of growth rate in a sarcoma cell culture was found to be 500 r. The corresponding dose for normal chicken fibroblasts is 2,500 r.

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X-Ray Evidence of Old Forgotten or Previously Undiagnosed Fractures¹

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WHEN A PATIENT sustains a fracture, will he know it (a) at once or (b) some time later? Certainly it is a concept rather regularly accepted by the laity that when a bone is broken there is considerable pain, and more or less dysfunction is also to be expected. Medical opinion would accept this concept as true in the large majority of cases, but every physician seeing injury cases has the experience of occasionally finding fractures which have escaped clinical diagnosis altogether and of noting complete lack of immediate disability and relative absence of pain in some of these patients.

The location of the fracture and the importance of the bone affected in permitting free function of the part are undoubtedly significant factors. The pain threshold of the individual is another important consideration in determining whether or not medical attention and diagnosis are sought, leading to an immediate diagnosis of fracture. Religious convictions may at times militate against prompt diagnosis. We have seen several fractures undiagnosed for months, the chief factor contributing to the delay being the religious faith of the patient, which encouraged him to get along without a physician's attention.

That every fracture must immediately cause the patient considerable pain, so that he will probably remember the time and circumstances of the injury throughout the remainder of his life, and that self-noted disability will follow, more or less promptly, are often argued by attorneys in court or before industrial commission examiners when a diagnosis of fracture has first been made months or even years after its occurrence. If the client can honestly testify that he has no recollection of having previously injured his wrist, chest, ankle, or other part, or of receiving any treatment for fracture or serious injury, and the medical witness testifies that the radiographic studies point clearly to an ancient, previously undiagnosed fracture, the attorney will sometimes attempt to belittle the medical evidence by asking confidently, for the benefit of the jury, or commissioner, and his client: "Don't you think, Doctor, that if my client did fracture this wrist years ago, as you contend, he certainly would be able to remember that fact now and he would surely have consulted a doctor?"

It is our impression that it is not unusual for certain fractures, notably of the carpal scaphoid, the mid and lower ribs, the metatarsal, metacarpal, and phalangeal bones, to pass undiagnosed and untreated as fractures. Some of these missed

¹ Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.

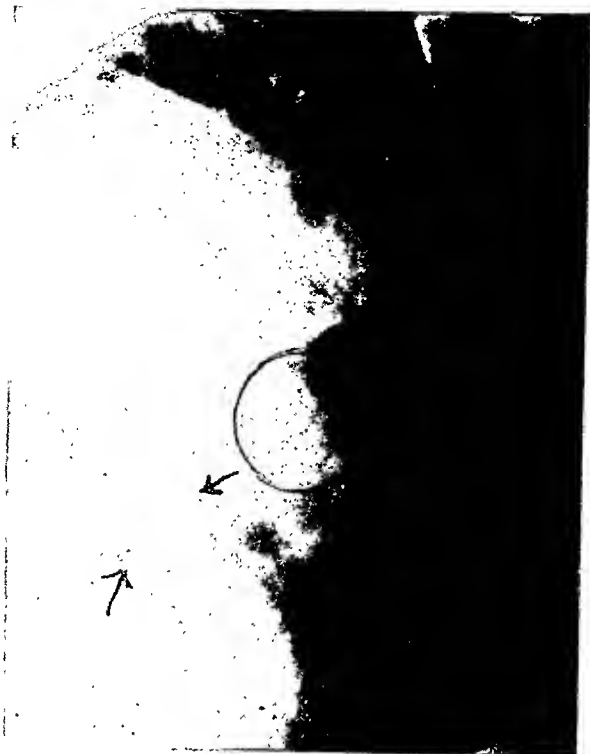


Fig. 1. Case 1: Old, unrecalled healed fracture of 11th rib (arrows) and fresh fracture of 10th rib (circled) following a recent fall. Old rib injuries stoutly denied.

diagnoses are followed by excellent functional recovery, and later only radiographic deformities can be found as positive evidence of an old healed fracture. In such cases no one is the "loser." When, however, a carpal scaphoid fracture, for example, is diagnosed for the first time only years after the original injury, following further trauma, considerable dissatisfaction on the part of the claimant and his attorney is likely to follow if the gradually evolved deformity or dysfunction is not fully compensated for financially. It is under such circumstances as these that the attorney will attempt to discredit the testimony of the radiologist, industrial surgeon, or orthopedist, who states with conviction and complete honesty that the fracture revealed is an old one, dating back at least a year or more, leading gradually to the development of secondary traumatic arthritis and/or nutritional disturbance with gradually increasing pain and dysfunction.

Except for the discrepancy between the

history and the x-ray findings, there is nothing very unusual about most of the fractures discussed in this paper. They occur in the usual location in bones commonly involved in fractures, and their manner of healing has been, in most instances, according to the usual pattern.



Fig. 2. Case 2: Old, unrecalled, previously undiagnosed fractures of 6th and 7th ribs, left. No previous chest injuries recalled or admitted.

The chief purpose in presenting this material is to emphasize the occasional lack of correlation between past history and medical care on the one hand and the x-ray findings on the other. So regularly have we been taught to be guided by the history and, often very properly, to disregard laboratory or x-ray findings when they are in disagreement with clinical observations and history, that we tend to overemphasize the reliance to be placed on the latter. These cases show either that there may be failure of memory of the incident or accident which caused the fracture revealed months or years later in the x-ray studies, or, what is probably the more usual correct explanation, that there was not sufficient pain or dysfunction to impress the circumstance

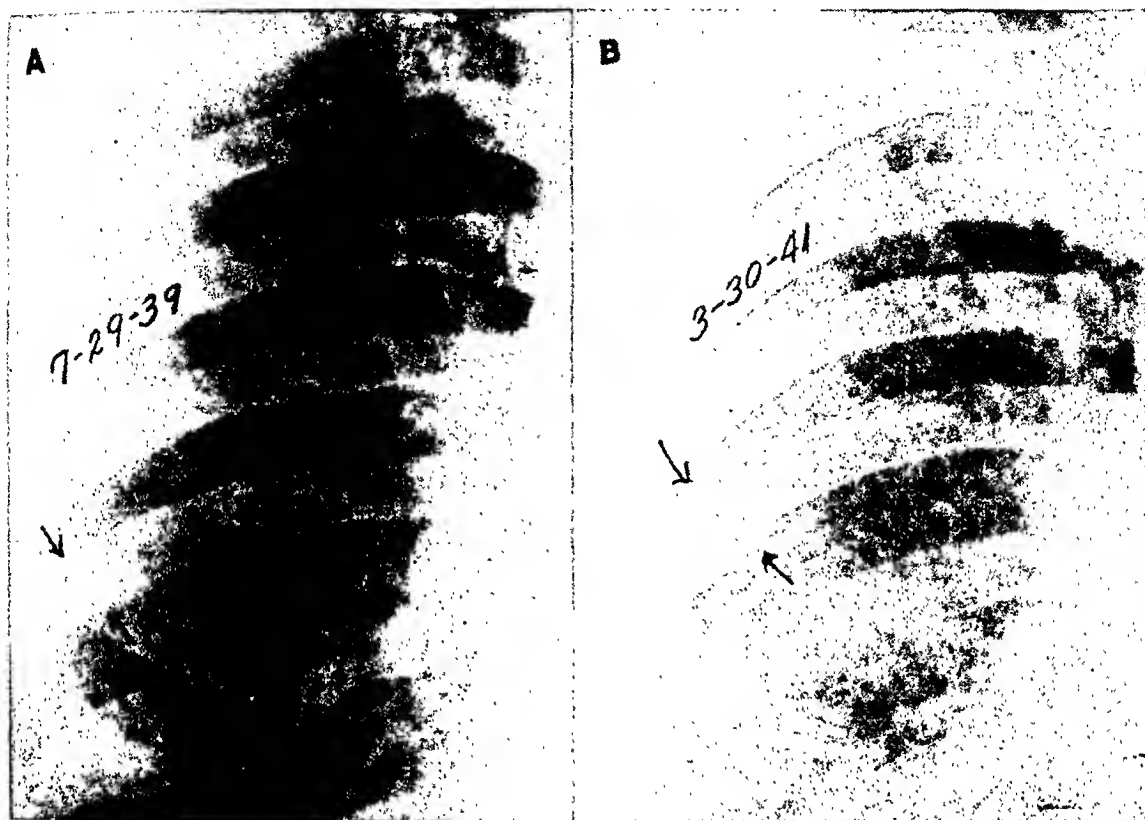


Fig. 3. Case 3: A. Essentially normal chest. B. Same chest approximately two years later, showing healed fracture of right 8th rib. In testimony before an Industrial Commission the patient denied any recollection of chest injury, though this must have occurred less than two years earlier as proved by serial films.

indelibly upon the patient's mind. The natural healing which followed, despite lack of physician-attention resulted in complete recovery or in sufficiently complete recovery for the time being to make it impossible at the later date to correlate the x-ray evidence of an old fracture with the exact time of its occurrence and the exact circumstances under which it was sustained.

Rib fractures are a bit different from other fractures. Some physicians contend that if an injury is sustained to the chest wall, barring concurrent intrathoracic trauma, it makes little difference, except for medicolegal purposes, whether or not a diagnosis of rib fracture or fractures is established, since treatment to relieve the pain, by strapping, is quite the same whether a fracture is radiographically demonstrated or is left unstudied. This attitude we consider outmoded, particularly if any question of compensation is involved, both because of occasional intra-

thoracic complications, which cannot always be diagnosed clinically, and because of the possibility of a late claim for the activation or aggravation of a pre-existing tuberculosis or other chronic disease, the presence of which was not studied carefully at the time of the injury. We hold that in all injuries to the thoracic cage, except possibly those low down posteriorly, over the level of the 11th and 12th ribs, beneath which no portions of the intrathoracic structures lie, the patient should have the benefit of at least a single rapid-exposure postero-anterior teleroentgenogram of the entire chest for the purpose of lung and heart study, so that the presence of any pre-existing pulmonary or demonstrable cardiovascular lesion may be recorded at the time of checking the ribs and other bony structures for fractures. Only by making this a routine, will the radiologist or industrial physician be in a position to evaluate the relationship between the

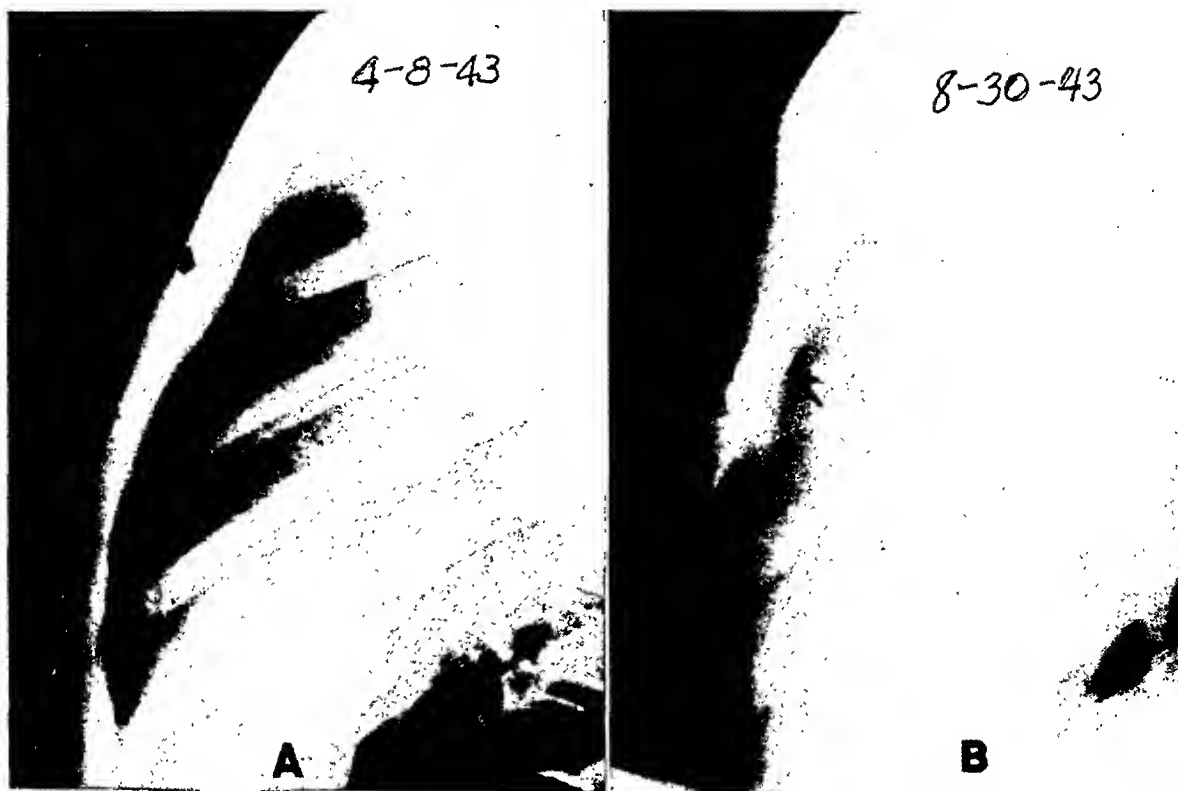


Fig. 4. Case 4: A. Recent fracture of upper sternum, not previously recognized or suspected, revealed by x-ray study because of breast nodule. The patient, a 13-year-old boy, had fallen five weeks previously but had no recollection of striking any part of the chest wall.

B. Film made five months later, showing mature healing of sternum fracture, proving finally its occurrence shortly prior to first x-ray study.

chest injury and a subsequently developing tuberculosis or other intrathoracic disease process which later may become manifest clinically.

Fractures occurring under unusual circumstances, as, for example, complete transverse fracture through the mid portion of the patella in a young adult as a result of muscle pull only, with no direct blow to the part, may conceivably be missed because the history may be somewhat misleading to the physician with no previous experience of fracture from this cause alone. Such fractures, however, if amenable to correct physical diagnosis, would not go unrecognized and unstudied radiographically.

Fractures occurring in patients with syphilis of the central nervous system or other disease which may make for a high threshold of pain perception may be missed even though there is a history of trauma adequate to produce fracture, if the

physical examination gives no suggestive findings. Such patients may be dismissed as having contusion or sprain only, until some later occasion justifies radiography and reveals the previously missed fracture, now an ancient one.

Sometimes it is simple stubbornness on the part of the patient, in holding to his original self-diagnosis of "nothing broken," which sustains him in his decision to do without medical care; or, rarely, where so-called minor injuries may be handled by an industrial nurse, the decision may be made by her that a physician's attention is not necessary.

Jordan-Narath (2) discussed at some length fractures which are missed radiographically if examination is done too soon, inadequately, or inexpertly. He placed no emphasis, however, on ancient fractures revealed by x-ray study, for which no history of injury was obtainable.

Owen (4) points out the likelihood of

overlooking a fracture in one part of the body (for example, the spine) when a fracture elsewhere focuses the attention of the examiner at that level (for example, the femur or tibia) because of greater pain and deformity, but he, too, makes no mention of encountering positive evidence of old healed or unhealed fracture where no history of injury was recalled.

Lancer (3) stated a principle fifteen years ago, now rather generally accepted by radiologist, orthopedist, and industrial surgeon alike, that "in many cases the x-ray diagnosis is the sole proof of fracture," but, like others, he had apparently not been impressed with the occasional lack of correlation between the roentgen evidence of old fracture and the patient's past history.

OLD CHEST INJURIES

Radiologic differentiation between normal chests and "healthy adult" chests has long been recognized and understood by radiologists. A Ghon's focus, calcified hilar or mediastinal lymph nodes, pleural adhesions affecting the diaphragm, and slight thickening of the interlobar or apical pleura, have all been accepted as changes which may be present singly or in combination and still permit the interpretation of "healthy adult" chest. We believe one could add to this list the observation of old healed fracture or fractures of the ribs or clavicle, which will sometimes be found where there is no recalled history of previous diagnosis of fracture or treatment for such an injury.

Localized deformities and thickenings characteristic of old healed fracture of one or more ribs have been found in the usual areas of rib fracture; namely, in the region of the angle or in the axillary portion. Some patients are in the higher age groups, and it is possible that the absence of a history of injury may be merely a matter of failing memory; in a larger number we believe that it is simply a case of a rib fracture having occurred (the same holds true for the clavicle or sternum, though less frequently), which was evaluated by the



Fig. 5. Case 5: Previously unrecognized fracture of the manubrium. The patient had sustained a compression fracture of the 4th dorsal vertebra upon which clinical interest was centered.

patient or his parents as being not sufficiently serious to warrant medical attention and diagnosis. As previously stated, we recommend that all patients with chest injuries which for medicolegal or other reasons are considered sufficiently important to justify x-ray examination, be given the benefit not only of regional study of the ribs suspected of fracture, but also of at least a single teleroentgenogram of the entire thorax, as a matter of record in the event of a subsequent claim for the activation or aggravation of intrathoracic disease.

CASE 1 (Fig. 1): *Old healed fracture of 11th rib (arrows) and fresh fracture of 10th rib (circled) posteriorly.* One day prior to x-ray study the patient, aged 44, pulled over a barrel and fell against a crate. Former rib injuries were stoutly denied. When did the 11th rib fracture occur? Obviously *not* as a result of this recent injury, but certainly as a result of some earlier unrecalled trauma, perhaps in childhood.

CASE 2 (Fig. 2): *Old, unrecalled, undiagnosed fractures of left 6th and 7th ribs.* Figure 2 is a pre-employment chest film of an industrial worker aged

62. The only recalled injury was a smashed right thumb twenty years earlier. There had been no previous x-ray examination of the chest.

CASE 3 (Fig. 3): *Recent healed fracture of 8th rib, with no admitted history of injury.* A foundry employee, aged 48, had serial x-ray examinations of the chest during exposure to dust as a chipper and grinder. Figure 3A, taken July 29, 1939, shows a normal thoracic cage. Figure 3B, taken March 3, 1941, shows a healed fracture of the right 8th rib

of less than two years' duration. Yet the obtainable history is inconsistent with the positive x-ray findings, and in the light of "objective evidence" it must be adjudged misleading and unreliable.

CASE 4 (Fig. 4): *Recent, previously unrecognized fracture of uppermost segment of the body of the sternum.* A 13-year-old boy had a chest examination

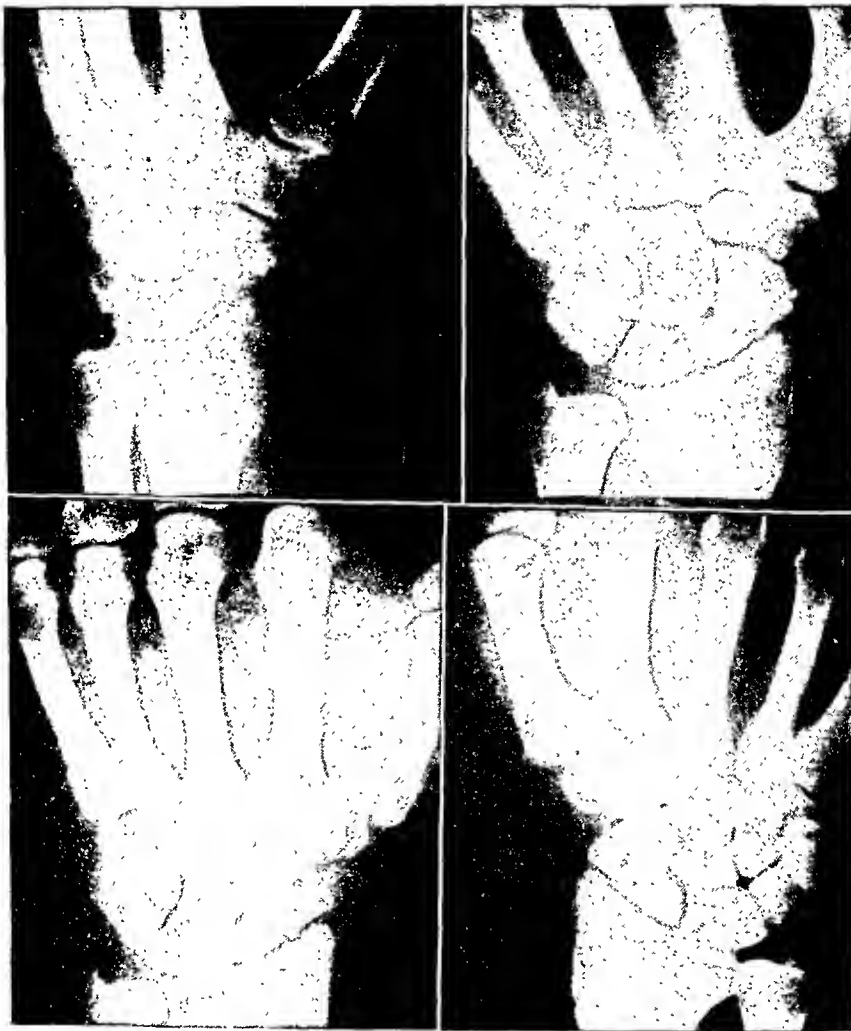


Fig. 6. Case 6: Old, previously undiagnosed fracture of the carpal scaphoid. "Sprain" of wrist 30 years ago. No previous roentgen study.

posteriorly, near the angle, with a trace of downward displacement of the anterior fragment. No history of injury to the chest wall, recalled or admitted by the claimant (who had silicotic fibrosis), was obtained by several medical examiners in preparation for an industrial commission hearing.

Comment on Case 3: This case is an instance where serial x-ray studies proved that the injury causing the rib fracture was

because of a small lump in the left breast, near the nipple. A lateral film taken routinely revealed a slightly depressed greenstick fracture of the upper sternum. A "retake" history disclosed a gymnasium injury five weeks previously, when the patient dropped from parallel bars. No blow to the chest wall over the sternum was recalled (instance of fracture as a result of involuntary deep "breath-catching"?). Re-examination four months later (Fig. 4B) showed the fracture of the sternum (not

suspected or clinically diagnosed prior to x-ray study) to be completely healed, proving its occurrence to have been shortly before the original x-ray study.

CASE 5 (Fig. 5): *Previously unrecognized healing fracture of the manubrium.* The patient, about four weeks previously, had fallen down the cellar stairs, injuring the upper spine. The head and neck were carried sharply forward, and a fracture of the spine in the upper dorsal region was suspected. X-ray examination showed a compression fracture of the 4th dorsal vertebra plus an undiagnosed fracture of the manubrium, with overriding of the fragments.

Comment on Case 5: This is an example of one fracture producing gross deformity, evident on physical examination, leading the attention away from a second fracture causing little or no deformity.

OLD UPPER EXTREMITY INJURIES

Undoubtedly the most important and most frequent fracture in the upper extremity—from the standpoint of the loss of function—to go unrecognized for years and to show lack of correlation of x-ray findings and an adequate history of previous injury dating sufficiently far back, is that of the carpal scaphoid or navicular bone. In our experience, which includes both hospital and private practice and a fair amount of consultation work on cases which have been studied roentgenologically elsewhere, about three old scaphoid fractures (a majority of these being previously undiagnosed) are seen to every fresh scaphoid fracture. Unquestionably it would help the average examiner caring for industrial injuries if every x-ray study of the wrist made following recent trauma included one or two special views taken for the primary purpose of ruling out scaphoid fracture. A postero-anterior oblique view with the radius away from the film and a direct postero-anterior projection with the wrist in acute dorsiflexion are the most useful special positions.

It was our impression for a long time that the reason for lack of correlation between the clinical history of wrist injury and the x-ray evidence of an old carpal scaphoid fracture lay in the long interval between the occurrence of the original

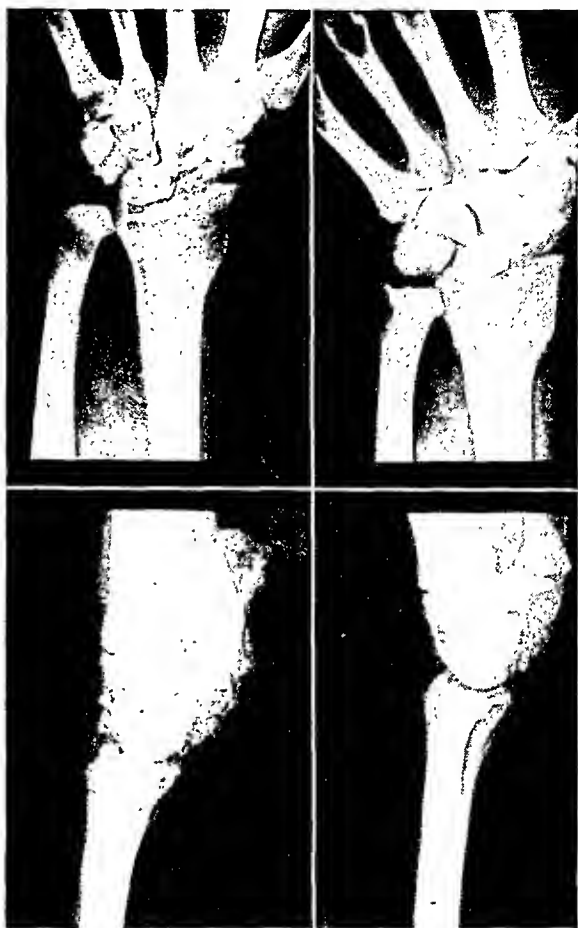


Fig. 7. Case 7: Old, unrecognized, previously undiagnosed scaphoid fracture. History of recent blow to wrist by machine hammer and similar injury six months previously. Marked changes in radius and carpus favor some more ancient trauma as the cause; no such injury recalled by patient.

trauma and the roentgen examination leading to the eventual diagnosis of old ununited fracture. Recently, however, we have had an experience which suggests rather that the unspectacular nature of the accident and the lack of severe symptoms immediately following, are probably equally important factors. The case in mind is that of a boy, aged 12, who sustained a minor injury to the right wrist. In the process of exactly evaluating the fracture of the distal diaphysis of the radius, studies of the left wrist were made, showing an old ununited fracture of the left carpal scaphoid. The boy participated almost constantly in athletics, but he could recall no injury to the left wrist of severity equal to that sustained by the

right one just prior to our study. The possibility of a developmental anomaly (bipartite scaphoid) was carefully considered, since at the time of initial radiography there seemed to be no restriction of motion or weakness of muscle power in the left wrist. A year and a half later, however, on recheck examination, evidence of some post-traumatic arthritis had already de-

veloped; the patient was himself now aware of restricted motion in the part (discomfort in this wrist on doing "hand-stands"), and there was easily determinable limitation of motion, particularly dorsiflexion and volar flexion.

The rather rare patella cubiti, in the majority of instances reported in the literature and likewise in our experience (1), is seldom presented for diagnosis prior to

adult life, though it is probably attributable to a childhood injury, an avulsion of the olecranon epiphysis, which passes unexamined and undiagnosed. We have seen at least one case of this condition with absolutely no recalled history of old injury to the elbow to permit estimating the approximate date of development of the abnormality. In each of 3 other cases

which we have had an opportunity to study there was a history of childhood trauma, although not always with a clinical or radiologic diagnosis of avulsion of the olecranon epiphysis.

Not so very rarely we have encountered very obvious old healed fractures of one or another of the metacarpal bones or of a phalanx, in which no old injury to the hand or finger was recalled by the patient.

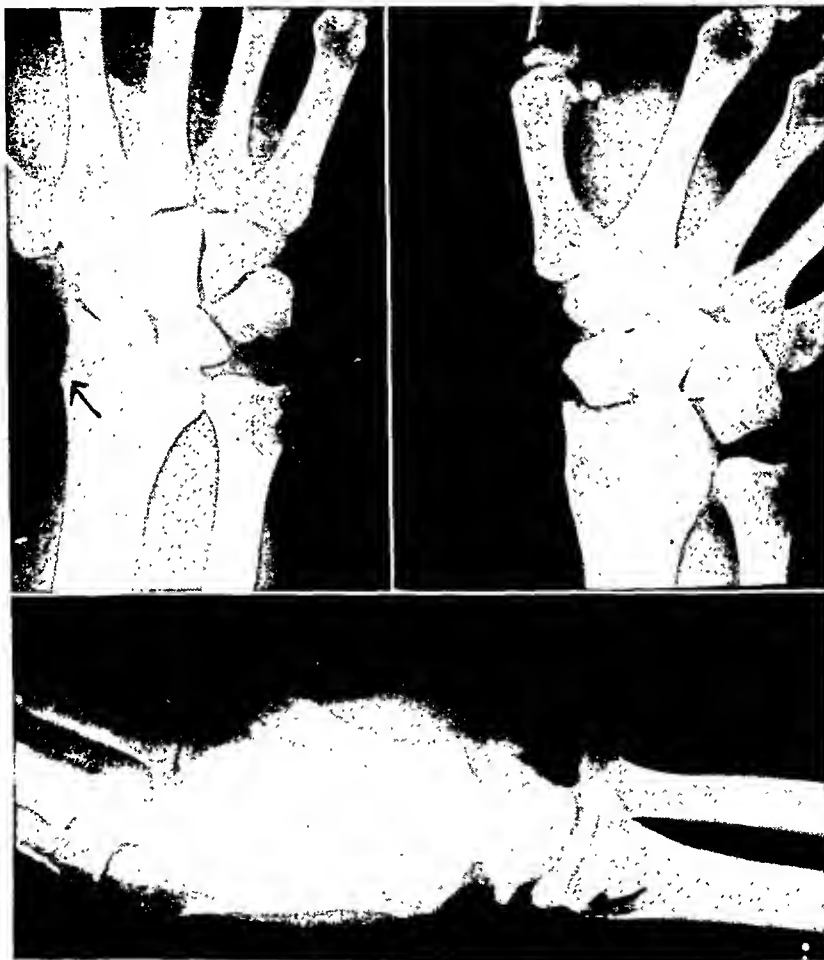


Fig. 8. Case 8: Old, ununited, previously undiagnosed scaphoid fracture and minimal fresh fracture on lateral aspect of radius. Old injury denied.

We have likewise seen at least one instance of deformity and lack of complete development of both the radius and the ulna, best explained on the basis of an injury at or near the epiphyseal cartilages in early childhood, in which no such injury was recalled. The only awareness which this patient had of his abnormality was due to restricted motion without muscular weak-



Fig. 9A. Case 9: Old, unrecognized, previously undiagnosed fracture of scaphoid in athletic boy, who recalled no injury. Recent trauma to opposite (left) wrist only.

ness in the wrist joint and the necessity of having the sleeve shortened approximately two inches on the affected side whenever a suit or overcoat was purchased.

CASE 6 (Fig. 6): *Old, ununited, previously unrecognized navicular (scaphoid) fracture.* A man, aged 58, slipped and fell while at work. He recalled a "sprain" of the same part thirty years earlier. No x-ray examination had been made on that occasion (1913).

CASE 7 (Fig. 7): *Old, unrecognized, previously undiagnosed navicular (scaphoid) fracture.* A millwright, aged 57, had his wrist struck nine days previously by a machine hammer. He had suffered a similar accident six months before, of about the same

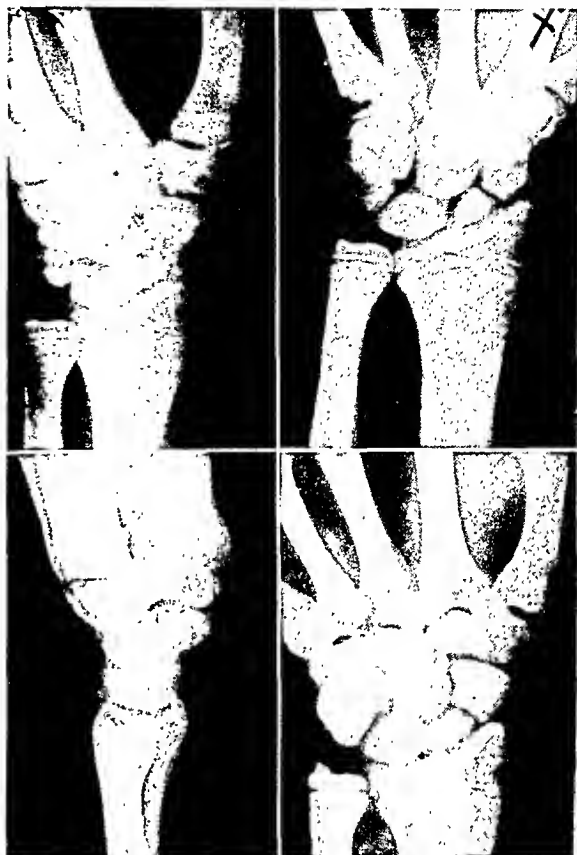


Fig. 9B. Case 9: Film made a year and a half after 9A, showing slight hypertrophic spurring on scaphoid and radial styloid.

severity, but recalled no earlier injury. Marked nutritional changes in the navicular fragments and adjacent carpal bones and changes in the lower end of the radius almost certainly date back more than six months, to some unrecalled trauma.

CASE 8 (Fig. 8): *Old, ununited, previously undiagnosed navicular (scaphoid) fracture; old trauma denied.* A patient, aged 35, gave a history of recently jerking and striking the wrist while passing through a door. The roentgenogram showed a minimal fresh cortical fracture (arrows) on the posterolateral aspect of the base of the radial styloid; also old spurring at the radial styloid tip and posterior aspect of the navicular.

CASE 9 (Fig. 9): *Old, unrecognized, previously undiagnosed navicular fracture.* The patient, aged 13 when first seen, was examined for recent trauma to the *left* wrist and a minimal fracture just above the epiphyseal cartilage was demonstrated. The *right* wrist was examined for purposes of comparison, and an old scaphoid fracture was discovered. It is to be emphasized that this child was unable to recall when this fracture occurred. As this was not an industrial accident and compensation was not involved, there was no reason for willful "forgetting."

A serial film made one and a half years after the

first study is reproduced in Figure 9B. The boy is now beginning to show some of the clinical evidences of a chronic wrist lesion; motion is moderately restricted, particularly dorsiflexion (does "hand-stands" with difficulty, notices pain when throwing baseball hard). Slight hypertrophic changes are developing on the tip of the radial styloid and distal fragment of the navicular.

OLD LOWER EXTREMITY INJURIES

In our experience fractures of the lower extremity which have escaped diagnosis because of lack of adequate medical examination, or absence of pain of sufficient intensity or duration to demand medical



Fig. 10A. Case 10: Old, previously undiagnosed fractures of distal radius and ulnar styloid. No old injury recalled.

CASE 10 (Figs. 10A and 10B): *Old, previously undiagnosed fracture of distal right radius and ulnar styloid.* A patient, aged 36, struck his hand on a machine. No previous injury was recalled. In view of 1 1/2 inch shortening of the radius and 1/2 inch shortening of the ulna as compared with the other arm, it is probable that there had been an injury in early childhood, resulting in nutritional disturbances to the epiphyseal cartilages. Prominence of the ulna in the right wrist had been recognized since the age of twenty.

care at all, are (1) those occurring near the upper and lower ends of the fibula, (2) metatarsal fractures, and (3) phalangeal fractures. It is easy to understand the relative lack of pain in fractures of the upper or lower ends of the shaft of the fibula and in fractures of a single metatarsal bone, because of the splinting effect of the other bones present at the same level.

We have seen fractures of the phalanges of the foot missed occasionally, even by the experienced industrial surgeon who sees finger and toe injuries rather frequently. Occasionally, the limited amount of swelling and pain tends to suggest strongly that

possibility of such an occurrence. In these cases, unless the clinical complaints or objective findings are sufficiently positive to indicate the necessity for radiographic study, the fracture may be missed. We recall one case in a man of about 55, an in-



Fig. 10B. Case 10: Shortening of right radius (1 1/2 inches) and ulna (1/2 inch) as compared with opposite arm, due presumably to injury in early childhood, involving epiphyseal cartilages.

no fracture has occurred, and only when some later injury to the same area occurs will evidence of the old, undiagnosed, clinically unsuspected fracture be found. We have observed fractures of the metatarsals and of the fibula in which the roentgen evidence has been quite typical; yet the patient was unable to recall any past injury at either of these levels. In some of these cases medicolegal considerations played no part; hence they cannot be explained on the basis of willful "forgetting."

Occasionally one will encounter a fracture though the nature of the injury would almost positively argue against the

dustrial employee, who came to the clinic complaining of pain in the hip region. He walked with a limp, requiring the use of canes or a crutch. The only admitted injury was a twisting, lifting strain from which, one would ordinarily conclude, a transcervical fracture in a normal bone structure could not occur. Radiographic examination, however, disclosed such a fracture, not markedly impacted, yet holding sufficiently to permit some limited weight-bearing. The patient remained ambulatory for a period of several weeks until, despite the history, which seemed rather conclusively to negate the idea of

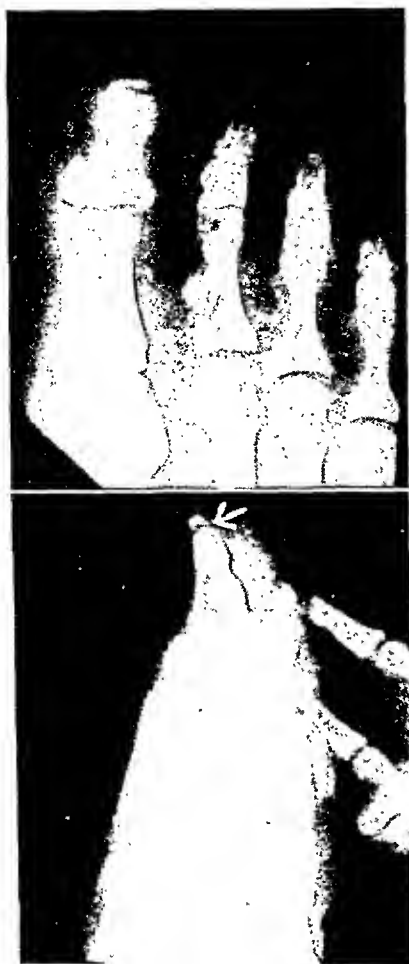


Fig. 11. Case 11: Old, ununited, previously undiagnosed fracture of tip of distal phalanx. The patient had recently dropped a heavy object on the toes. A similar accident had occurred eight months earlier but no x-ray examination was done.

femoral fracture, it was decided to carry out a radiographic study. This revealed a fracture of the femoral neck.

CASE 11 (Fig. 11): *Old, ununited, previously undiagnosed fracture of the distal end of the distal phalanx of the great toe.* The patient, aged 32, had recently dropped an object on the foot. A similar accident to the same part occurred eight months earlier. This had received the usual medical care except that no x-ray examination was done.

CASE 12 (Fig. 12): *Old, healed, previously undiagnosed fracture of proximal phalanx of middle finger.* Three days before examination, the patient, aged 47, had smashed the finger while at work. Previous injury to the part was denied.

CASE 13 (Fig. 13): *Old, previously undiagnosed fracture of lower end of fibular shaft.* The patient, aged 50, had recently "twisted" the ankle. There was no fresh fracture. A retake history disclosed a



Fig. 12. Case 12: Old, unrecalled, healed fracture of proximal phalanx. The patient smashed the finger three days before examination, but denied previous injury to this part.

fall on the ice two years previously. The patient had received no medical care at that time; only self-treatment for "sprain."

CASE 14 (Fig. 14): *Old, healed, previously unrecognized, undiagnosed 5th metatarsal fracture (arrow).* This 38-year-old patient dropped a casting on his foot. In a "retake" history, he recalled stubbing the little-toe side of the foot twelve years earlier. He saw no doctor at that time, and no x-ray examination was made previous to the present study.

CASE 15 (Fig. 15): *Old, healed, previously undiagnosed fracture (or fractures?) of proximal shaft of the 2d and probably proximal shaft of the 3d metatarsal; old bowing deformity of the 2d metatarsal (arrows).* The patient, aged 63, dropped a heavy object on the foot, causing fresh fractures of the proximal shafts of the 1st and 2d metatarsals (circled). No previous injury was recalled.

CASE 16 (Fig. 16): *Old, healed fracture of left calcaneus; original history negative for old injury.* The patient, aged 57, received a recent twisting injury to the left ankle. A "retake" history elicited recollection of a fall from a roof at the age of 18. The patient saw a "bone-setter" (not a physician) and following manipulation continued to walk on the injured part, returning to carpentry work after a six-day lay off.

SPINE, SKULL, AND PELVIS INJURIES

Certainly it is hard to think of a person having a major fracture of the spine or pelvis and doing well when the diagnosis of fracture is missed and proper treatment is not promptly instituted. Nevertheless, one occasionally encounters such a situation, particularly if some other condition, such as a leg fracture requiring a period of bed rest, has resulted from the same injury. It is our impression that in older people who are not too inactive but are engaging in no heavy manual labor or other strenu-

ous physical activity, a mild compression fracture of a vertebra may be followed by satisfactory clinical recovery with no marked "kummelling," despite the omission of reduction, plaster fixation, or brace fitting. That anyone could sustain a severe compression fracture of the spine with associated luxation, have symptoms for only a few days, and go a period of fifteen years before even having an x-ray study,

nitely, except that a second trauma to the same side of the pelvis, eight months after the original injury, caused a subcapital fracture of the femur which necessitated hospitalization and x-ray study. This showed both the recent femoral fracture and the old healed fracture of the ilium with exuberant callus, which until that time had been accepted as a "contusion" and so treated.



Fig. 13. Case 13: Old, healed, previously undiagnosed fracture of lower end of shaft of fibula. History of fall two years earlier, with self-treatment for "sprain."

seems most unlikely; yet such was the situation in one of the cases reported here (Case 18).

Fractures of the pelvis are seen oftenest as the result of major crushing or squeezing trauma and only rarely go clinically unsuspected or radiographically unstudied. One such case was seen, however—a long vertical fracture through the lateral aspect of the ilium, which went eight months undiagnosed. It might have gone so indefi-

Similarly it is seldom that we have found any appearance in the skull bones strongly suggestive of old fracture without a history of previous injury and clinical and x-ray diagnosis of fracture. A hospitalized patient was recently seen, however, who had sustained a concussion, together with a long laceration involving the right side of the forehead, in whom the radiographic appearances of the left side of the face were considered almost positively indica-

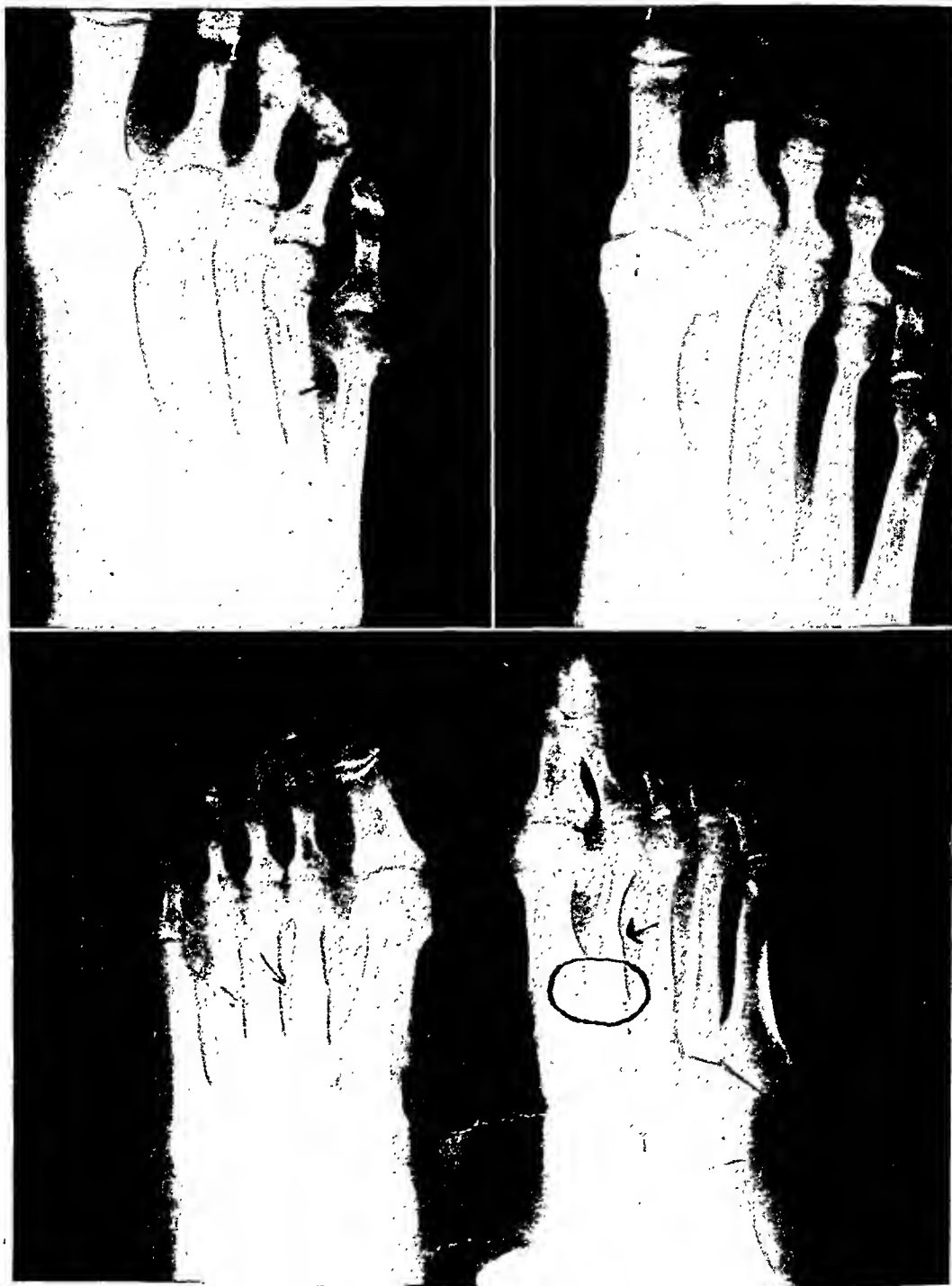


Fig. 14. Case 14: Old, healed, previously unrecognized fracture of distal shaft of little toe metatarsal bone. The patient recently dropped a casting on the foot; recalled stubbing little toe twelve years earlier. No x-ray examination then.

Fig. 15. Case 15: Old, unrecalled, previously undiagnosed fracture(?)s 2d and 3d metatarsals (arrows); fresh fractures 1st and 2d metatarsals (circled). No previous injury to foot recalled.

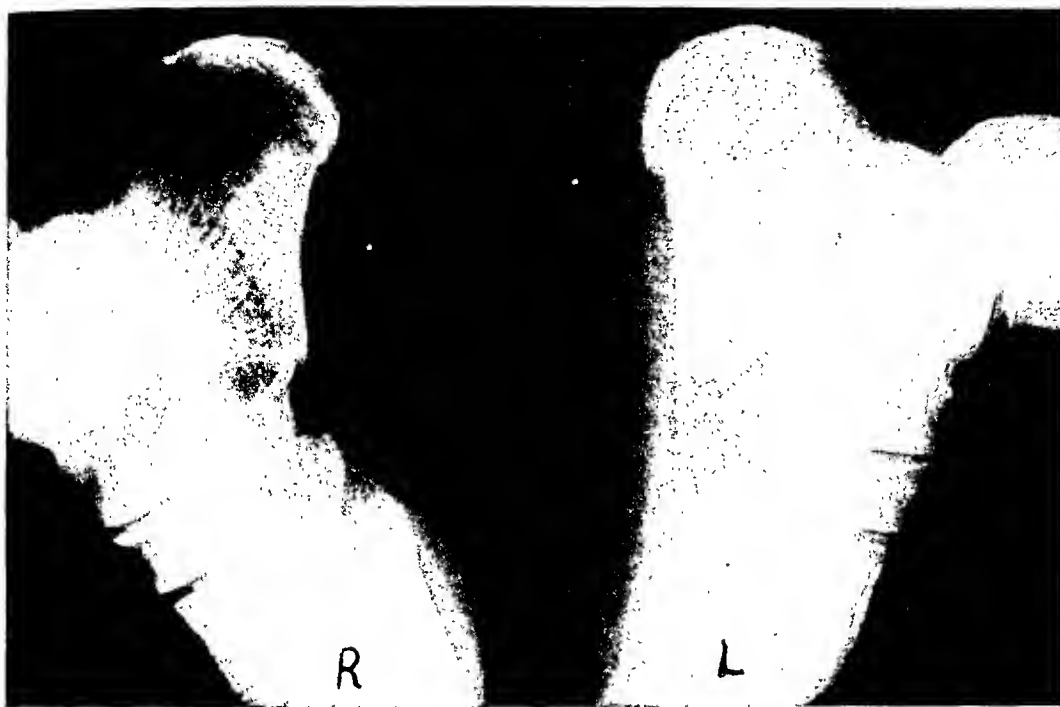


Fig. 16. Case 16: Old, healed fracture of left os calcis. Original history negative for old trauma. "Retake" history elicited recollection of fall from roof at age of eighteen (thirty-nine years earlier), treated by "bone-setter."

tive of an old healed fracture of the zygomatic process of the temporal bone. There was no tenderness or swelling over this area, and careful questioning in the "re-take history" to supplement the one already recorded by the intern elicited no recollection of old trauma at this level.

CASE 17 (Fig. 17): *Previously undiagnosed fracture of 10th dorsal vertebra.* A woman, aged 77, fell backward in the bathtub eight months before being examined roentgenographically. A substitute for her regular family physician taped her back and kept her in bed for two weeks. No further treatment was given. Recently she had experienced slight discomfort on forward bending but protested that there was no need for x-ray study. She had no further treatment following roentgen examination and recently stood a long auto trip with no apparent bad effects. This patient has now been observed for more than a year following the x-ray examination and continues free of symptoms and as active as prior to the fall.

CASE 18 (Fig. 18): *Previously undiagnosed severe compression fracture of the 12th dorsal with luxations between the 11th and 12th dorsal and 1st and 2d lumbar vertebrae.* A man of 36, about to be called for the draft, complained of upper lumbar backache for a few months only. He recalled a back injury at the age of 21, when he was thrown from a car. His back ached for three or four days, but he saw no



Fig. 17. Case 17: Old, previously undiagnosed fracture of 10th dorsal vertebra. The patient, aged 77, fell backward in bathtub eight months earlier and was treated by two weeks' bed rest and taping. Slight pain on forward bending.

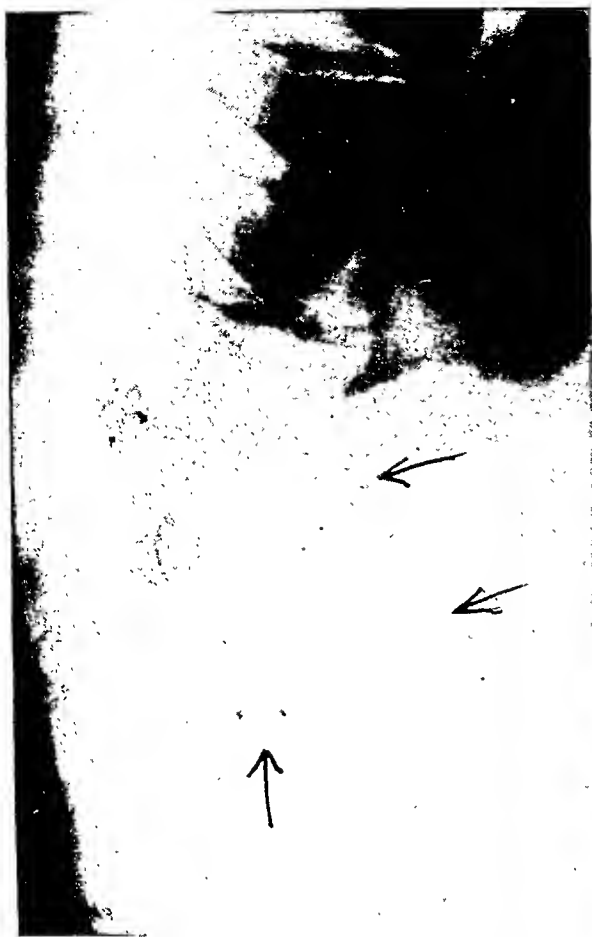


Fig. 18. Case 18: Old, previously undiagnosed fracture luxation of dorsolumbar spine. Auto injury fifteen years previously; no physician's care; no previous x-ray study. Recurrence of symptoms.

physician. He participated in sports, such as basketball and baseball, both previous to and following the accident. The roentgenogram shows marked thinning of the 11th dorsal disk and calcification in the anterior longitudinal ligament between the 1st and 2d lumbar bodies and posteriorly in the interspinous ligament.

CASE 19 (Fig. 19): Old, healed fracture of lateral aspect of ilium with exuberant callus, occurring in all probability eight months previously. This patient sustained a recent injury to the pelvis, resulting in a subcapital fracture of the femur. This was the second injury at this site, but there had been no diagnosis of fracture and no previous x-ray examination. The patient was known to be syphilitic and had received treatment several years previously for Charcot's knee in the same leg.

CASE 20 (Fig. 20): Old, healed fracture of left zygomatic arch with depressed deformity. A patient, aged 53, sustained a recent concussion and laceration in the right supraorbital region. There was no evidence of recent bony or soft-tissue injury of the left side of the face, and no old injury to the head was recalled (? residual of fist fight in childhood).

CONCLUSIONS

Roentgen evidence has been obtained of old healed fractures, involving every major part of the skeleton, which had gone unstudied radiographically and undiagnosed clinically from a few months to a number of years. In some cases a second injury to the same area led to the x-ray study which finally revealed the ancient fracture. At



Fig. 19. Case 19: Old, healed fracture on lateral aspect of ilium, with exuberant callus in a patient known to be syphilitic. Recent subcapital fracture of femur required hospitalization. Patient fell eight months previously, injuring same hip region; diagnosed "contusion"; no x-ray study.

other times a routine pre-employment examination of the chest or a radiographic study for some reason other than further injury permitted recognition of the previously missed fracture.

Of considerable interest and importance to the physician testifying in medicolegal cases is the complete failure of many of these patients to recall any old injury. Under such circumstances, we contend that, if the roentgenologic criteria of old fractures are positive, the x-ray evidence

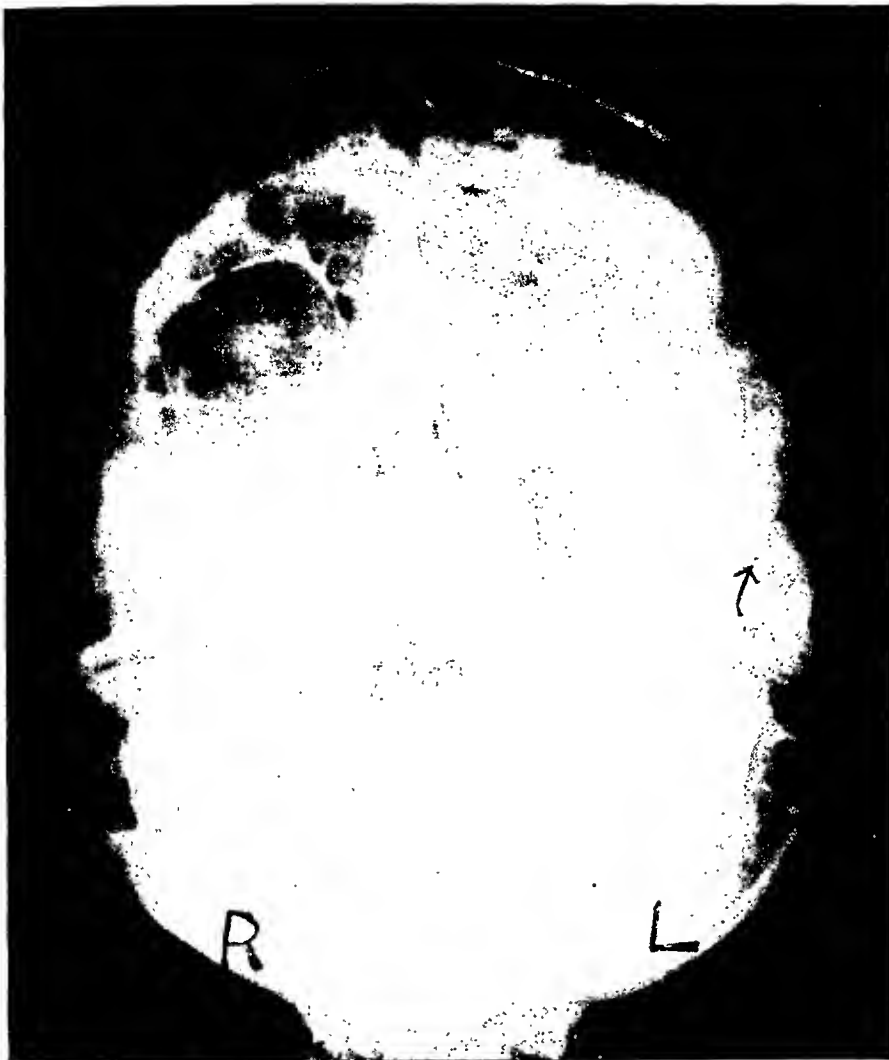


Fig. 20. Case 20: Old, healed, unrecalled depressed fracture of zygomatic arch. Recent laceration of opposite frontal region. No earlier injury recalled.

must be accepted at its full value, despite its apparent contradiction of the history.

It appears justifiable to conclude that fractures occasionally occur under such circumstances as to permit the condition to be: (1) undiagnosed, (2) untreated, or at least inadequately and unorthodoxly treated, and (3) ultimately forgotten.

Probably the commonest site of fractures undiagnosed, untreated, and ultimately forgotten, is the ribs. Usually no particular harm (dysfunction or increasing pain) results. The fracture which is perhaps of greatest importance as a source of increasing pain and dysfunction, though the original injury may be completely forgotten and there may have been no examination

or diagnosis, is that of the carpal scaphoid. Radiography in at least three positions in every case of wrist trauma would unquestionably reduce the incidence of missed diagnoses of carpal scaphoid fractures.

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"(b) Scarred infiltrative tuberculous lesions of the lungs, except that small fibroid or calcified lesions represented in roentgenograms as sharply demarcated strand-like or well defined, small, nodular shadows not exceeding a total area of 5 square cm. may be accepted after deferment until subsequent examination demonstrates that the lesion is stationary and not likely to be reactivated. The minimum period of time to determine this is six months. It must be recognized that either progression or regression of the lesion indicates instability. Clinical judgment, taking into consideration other factors, including age and race, must be exercised in estimating the likelihood of reactivation. Experience indicates a greater likelihood of reactivation of a lesion that appears to be stable in persons under twenty-five years of age than in older persons."

All soldiers, however, cannot be considered healthy and completely free of pulmonary conditions. A small percentage with pulmonary lesions were acceptable under the specifications of MR 1-9. In attempting to retain certain valuable men in the service, the regulation had to be broadly interpreted, for although a lesion may be discrete, have definite borders, and appear inactive, it is well known that activity cannot always be determined by one or even several x-ray examinations. Hospital observation is necessary. Kruger, Potter, and Jaffin (13), in agreement with Amberson (14), have shown that it is hazardous in many cases to attempt to decide whether a particular lesion is active or arrested, on the basis of a single examination. Only by serial films over a definite length of time can this question be solved.

It is also well known that under the conditions of civilian life a discrete minimal lesion may undergo no change and can therefore be considered "inactive." In Army life, however, fatigue, worry, lowered resistance, and irregular hours incident to training or combat can readily activate these latent foci so that the subject actually becomes a casualty and a burden to the government for the rest of his life. Richards (7), reporting on chest roentgen examinations in the Canadian Army, stated that 9 cases out of 328,325 broke down under military service. It must be added, however, that on the initial roentgen examination these cases were

reported as "doubtful" but "fit for service." This figure is small and may be insignificant statistically, but is indicative of the caution that must be exercised with roentgen examination.

Certain groups of soldiers, also, have been admitted into the Armed Services with pulmonary tuberculosis because of incorrect interpretation of the induction films, either as a result of technical errors, oversight on the part of the examining roentgenologist, or fatigue incident to an unreasonable number of readings at any one time. Richards found 11 cases missed in his series, an error of 0.003 per cent. In each instance, competent men had originally overlooked the lesion and, when the roentgenogram was reviewed, all agreed as to its presence. This percentage is admittedly low, but it must be pointed out that it is based on a review of cases subsequently proved to be pulmonary tuberculosis. The examiners did not know how many cases were missed that failed to become active during military service.

Not only has Army life proved deleterious to minimal lesions, but many roentgenologists in the military service have changed their attitude as regards the minimal fibrotic or fibrocalcific lesion. In civilian life, apical lesions of this character are often assumed to be arrested or inactive. Although they are noted, they are not considered significant. In the military service, however, many such lesions are regarded as active even though arrested. The tendency is to err on the side of safety in the interpretation of the roentgenogram.

OBSERVATIONS ON PATIENTS ADMITTED TO HOSPITAL WITH DIAGNOSIS OF TUBERCULOSIS

During the period Jan. 1, 1942, to Jan. 1, 1943, 4,019 patients were admitted to Lovell General Hospital, from station hospitals or overseas bases. Of this number, 122, or 3.03 per cent, were admitted directly to the tuberculosis ward. These represented all cases of either *proved* or *suspected* tuberculosis admitted to the

hospital. In this group there were 14 cases of non-pulmonary tuberculosis. Of the 108 remaining patients, 23, or 21.3 per cent, were admitted solely on the basis of routine x-ray examination of the chest. Eleven cases in this group, to be discussed later, were subsequently proved to be active and serial x-ray studies of the chest showed definite *progression* or *regression* while the patients were under observation. Had these examinations not been made, there is every reason to believe that the patients would not have been hospitalized. The roentgenograms had been taken either at the request of soldiers who had been contacts or during routine examinations for Officers' Candidate School. In each instance the patient was asymptomatic and considered to be in good health. The majority of the remaining patients were admitted because of cough, expectoration, hemoptysis, fever, or weight loss (see Table I).

TABLE I: SYMPTOMS IN 108 CASES OF SUSPECTED OR PROVED PULMONARY TUBERCULOSIS

Cough.....	75	(69.4%)
Expectoration.....	65	(60.1%)
Pain.....	61	(56.5%)
Fatigue.....	46	(42.6%)
Fever.....	45	(41.6%)
Weight loss.....	41	(37.9%)
Hemoptysis.....	35	(32.4%)
Malaise.....	34	(31.5%)
Dyspnea.....	31	(28.3%)
Night sweats.....	29	(26.8%)
Loss of appetite.....	24	(22.2%)
Hoarseness.....	16	(14.8%)
None: Patient hospitalized because of routine x-ray examination of chest.....	23	(21.3%)

It is to be noted that of those having definite complaints, the *initial* symptom was cough in 38 cases; pain in the chest in 11; chills in 5; dyspnea and fatigue in 4 each; weight loss and hemoptysis in 3 each. Many of the patients had experienced symptoms for three or more months before hospitalization. Of the 108 patients admitted, 75, or 69.4 per cent, were found to have pulmonary tuberculosis; in 46 of these, or 61.4 per cent, the disease was active. The lesions were classified as minimal in 37 cases (49.3 per cent); moderately advanced in 14 cases (18.6 per cent); far

advanced in 24 cases (32.1 per cent). The percentage of minimal cases is higher than is usually reported from tuberculosis sanatoria.² This is doubtless to be accounted for by the 23 cases admitted solely on x-ray evidence, in all of which the disease was classed as minimal. The age period in which the majority of cases was found was twenty-three to twenty-six years. In this group there were 46 cases. The mean age was twenty-four years. Upon admission, sputum examinations were done in each case. If these proved negative, gastric lavage was done and the washings were tested by guinea-pig inoculation and cultures. The sputum findings were positive in 30 cases. In 7 in which the sputum was negative the findings on guinea-pig inoculation of gastric washings were positive. One patient was admitted in a moribund condition and tubercle bacilli were found in the spinal fluid. In another the urine was found to contain tubercle bacilli. In 7 cases activity was manifested by changes noted on serial x-ray examinations of the lungs. In the latter group of cases, all other studies were negative. Of the 46 patients with active disease, 24 were enlisted men, the majority of whom were not examined roentgenographically on their entry into the Army. Induction x-ray studies had been made in 22 patients, as required by the Selective Service Act. Of those who had no enlistment x-ray examination, 12 had far advanced lesions, 5 moderately advanced, and 7 minimal. Among those examined roentgenographically at induction, 12 were found to have far advanced disease and 10 had minimal lesions. This is significant for, while numbers in the two groups are small, they are comparable. As will be shown later, in an appreciable number of cases lesions of impressive size were present on induction films. For reasons not understood, these were not noted. These soldiers should never have been inducted. The films, however, served a valuable pur-

² About 20 per cent.



Figs. 1 and 2. Case I (asymptomatic): Figure 1 (left) is a routine film of the chest, showing exudative infiltration in the anterior portion of the right first interspace and beneath the right clavicle.

Figure 2 (right) is an anteroposterior lordotic projection, revealing a cavity 8 mm. in diameter. This was not evident in the routine postero-anterior view of the chest.

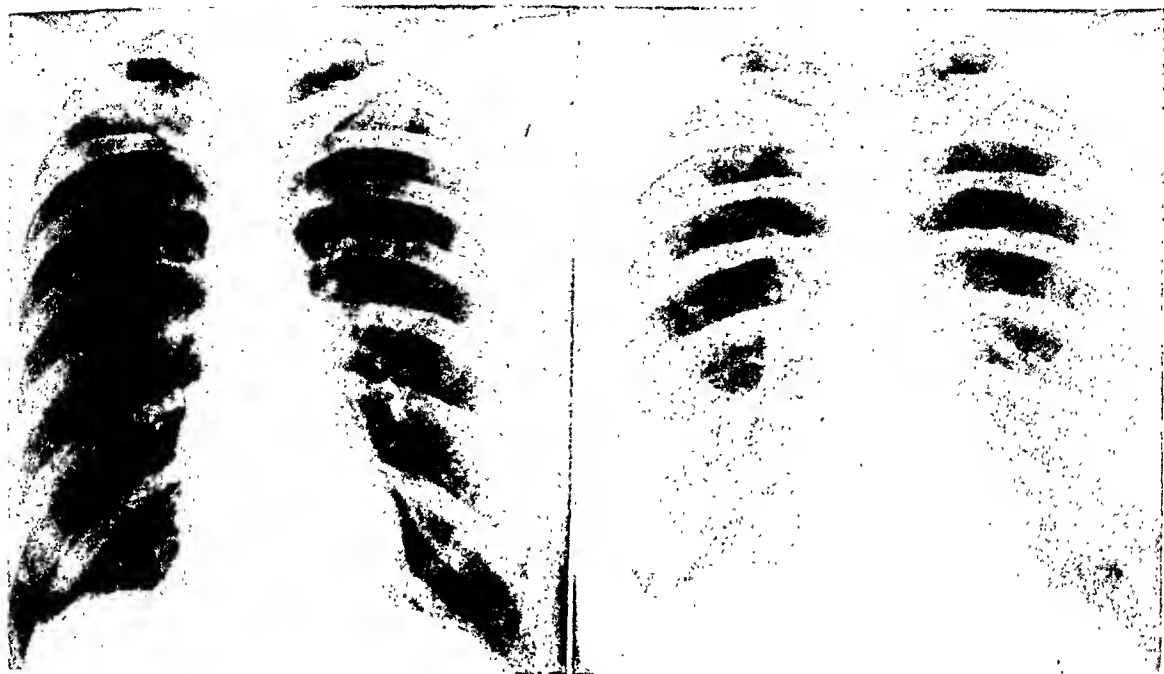
pose, for they assisted enormously in determining the age of the lesion and whether or not activity was present.

The determination of activity, while not difficult in the moderately advanced or far advanced cases, was exceedingly difficult in the minimal lesions, for many of these consisted of small infiltrates either at the extreme apex or periphery of the lungs. In each case, therefore, *all previous films were requested*, either from civilian hospitals, sanatoria, or the Veterans Bureau in Washington. This was done to ascertain definitely the time of the onset of the lesion and to determine whether any changes had occurred. Two enlistees had been treated in sanatoria in civilian life: in one patient the lesion was proved inactive. The second was found to be active, as manifested by a considerable regression.

Among the inductees examined roentgenographically upon their entry into the Army, 19 films were available for comparison. One patient with a negative induction film had pulmonary tuberculosis developing nine months later. *Thirteen patients had demonstrable tuberculous lesions at the time of induction.* Four were "considered acceptable under MR 1-9." *In 2 of these, the lesions were proved to be active and showed progression at the time of hos-*

pitalization. The remaining 2 cases had remained stationary. In 9 instances no note was made of the lesion at the time of induction, although it was demonstrable on the x-ray film. Four of these cases showed minimal involvement, but were proved active. One had remained stationary. The remaining 4 were far advanced upon admission, showing marked progression as compared to the condition on induction, which occurred three to five months before hospitalization. In 5 cases induction roentgenograms were not available but the histories revealed previous sanatorium care ranging from nine months to three years in duration. The lesions were verified on films obtained from the sanatoria and it must therefore be inferred that they were present in the induction roentgenograms. In this group, there were 4 with no change. The remaining patient showed definite activation. It is thus apparent that an enormous value is to be attached to the films taken at the beginning of military training. This value, however, is *commensurate with the quality of the photography and the care with which the film is interpreted.* Efficiency of clerical help may also be a factor.

Of the 23 asymptomatic cases admitted to the hospital solely because of findings on a routine x-ray study of the chest, 11



Figs. 3 and 4. Case II. Figure 3 (left), taken upon going on extended active duty, shows bilateral apical infiltration. The lesion in the left apex underlies the third posterior rib. The lesion in the right apex gives the appearance of an obliterated apical cap.

Figure 4 (right), taken Dec. 7, 1942, shows the left apical infiltration unchanged. The exudative lesion, measuring 2×2 cm., in the right apex indicates activity when compared with Figure 3.

(47.8 per cent) were proved active. In 6 of these activity could be determined only by serial x-ray examinations. All other laboratory data were persistently negative. Two patients had positive sputum. The remaining 3 active cases were proved active only by positive guinea-pig inoculation, which was confirmed. Twelve cases showed no change in serial x-ray examinations, and the laboratory results and clinical courses were negative.

OBSERVATIONS ON PATIENTS ADMITTED WITH NO DIAGNOSIS OF TUBERCULOSIS

In the period under consideration, 3,897 patients were admitted to this hospital for other than tuberculous conditions. On routine x-ray examination of the chest, 26 patients in this group were found to have asymptomatic pulmonary tuberculosis. The lesions were minimal, as manifested by apical infiltrates or areas of definite linear fibrosis. In 2 cases appreciable infiltrates were shown on the induction film and of these one was proved active. The remaining 24 patients in this group were

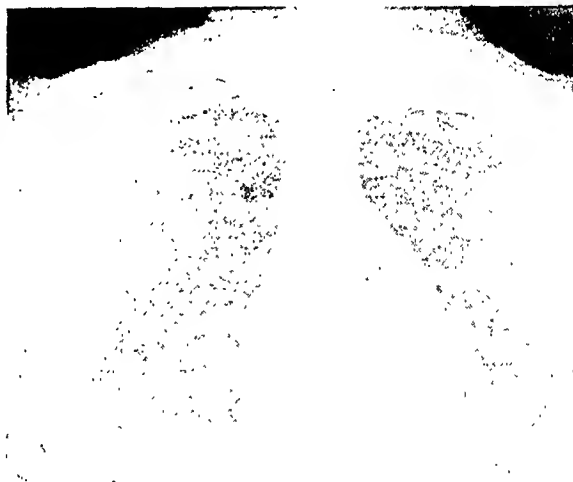
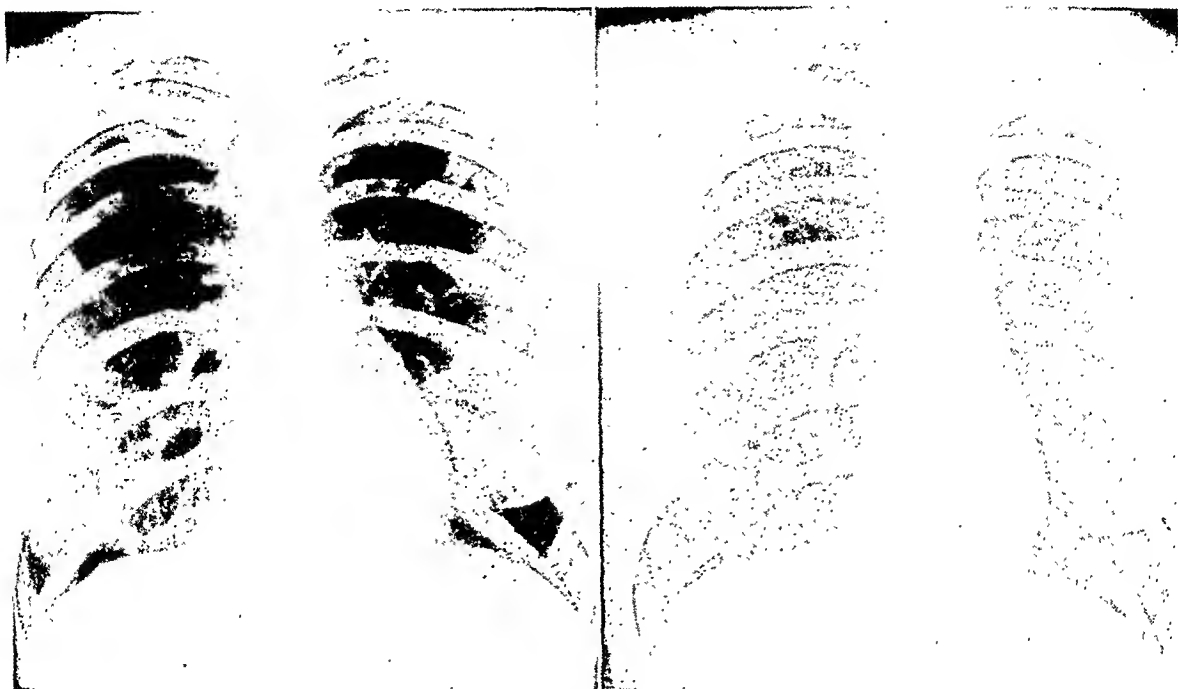


Fig. 5. Case II: Lordotic view showing to better advantage the right apical infiltration seen in Figure 4.

considered as having arrested or inactive lesions, after the necessary clinical observation.

OBSERVATIONS FOR ENTIRE GROUP

Altogether, in 21 instances earlier films were obtained for subsequent comparison, and 20 subjects were shown to have had



Figs. 6 and 7. Case III (asymptomatic). Figure 6 (left) is a routine chest film demonstrating calcified infiltrations in the extreme left apex and fibroid infiltrations in the left first anterior interspace.

Figure 7 (right), taken two months after Figure 6, shows increased extent of infiltrations in the left first anterior interspace indicative of activity. The patient was still asymptomatic and the laboratory data were negative.

tuberculosis prior to their entry into the Army. Of 21 cases for which previous x-ray studies were obtainable, 11, or 52 per cent, had been overlooked at induction, due probably to fatigue on the part of the roentgenologist incident to reading an unusually large number of films or to clerical error. Although the percentage of missed cases was higher than that found by Richards (7), it must be pointed out that it was based on a review of those cases which subsequently showed pulmonary tuberculosis, and that only 21 of the 75 cases proved active were reviewed by such a method. Because the number of inductees is not known, the actual percentage of error cannot be estimated. Long and Stearns (6) reviewed 53,400 chest x-ray films representative of men accepted at 89 induction stations in the United States. Among this number they found 271 showing infiltrative lesions, of which 173 were considered to represent inactive tuberculosis. The remaining 98 lesions were significant. It is apparent, therefore, that when facilities are available and the budget permits, all soldiers should have x-ray examination of the

chest on admission, for whatever reason, to a fixed installation.

ATYPICAL PNEUMONIAS: DIFFERENTIAL DIAGNOSIS

During the past two years an increasing number of atypical pneumonias have been reported. This is due partly to the increased number of chest roentgenograms taken of patients with respiratory diseases associated with fever. Differential diagnosis is difficult in protracted cases, and prolonged observation is often necessary to rule out pulmonary tuberculosis. In many instances, discrete lesions with well defined borders, having the usual character of a tuberculous infiltrate, have been demonstrated. These lesions resolve slowly, occasionally requiring from two weeks to three or more months for complete disappearance. For that period of time the patient is a tuberculosis suspect. In other cases, x-rays of the chest reveal diffuse lesions having a fibropneumonic appearance; in these, also, prolonged study and hospitalization are necessary to exclude tuberculosis. It is this condition which

accounted for the majority of admissions in our series of 33 cases subsequently proved to be non-tuberculous.

The differentiation between atypical pneumonia and pulmonary tuberculosis is often impossible if only one film of the chest is available. Kucel and Smetana (15) have reported a case of atypical pneumonia in which the roentgen appearance was so typical of tuberculosis that

lous lesions in the apical area. It is a simple method and one which entails no additional equipment. The technic employed by Major B. Copleman and Captain G. Lavner (17) is a reapplication of the method described by Fleischner (18) and later used by Lindblom (19), who found that the "semi-axial position permitted increased visibility of cavities and other processes in the apices of the lungs"



Fig. 8. Case IV (asymptomatic). Routine film of chest, showing exudative lesions underlying the clavicle and first anterior rib. The exudative lesion in the first anterior interspace with central translucency is suggestive of cavity, but subsequent studies revealed no cavitation.

pneumothorax was instituted. Ackermann (16), in order to determine the true nature of the lesions in his series, resorted to serial x-ray studies, "which permitted an exact study of the type of lesion encountered in individual cases, and also its progress, which alone is of decisive importance."

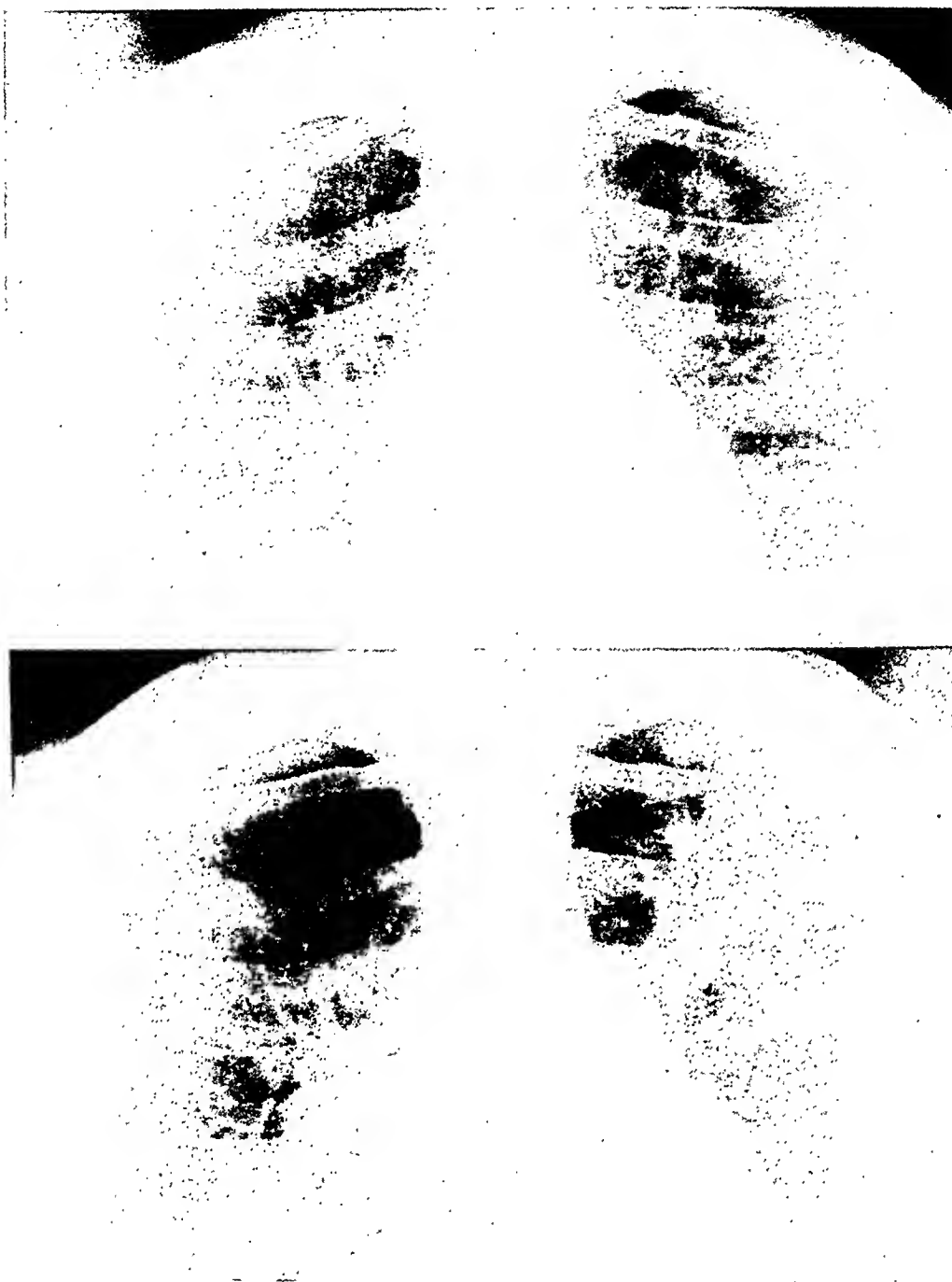
ANTEROPOSTERIOR LORDOTIC VIEWS IN THE STUDY OF MINIMAL APICAL LESIONS

Not infrequently, the so-called lordotic view has been found helpful as a means of disclosing hidden or ill-defined tubercu-

(20). The importance of this type of exposure will be evident in certain of the case reports describing apical lesions which were partly obscured by clavicles or thoracic bony structure.

CASE REPORTS

CASE I: C. R., aged 33, 2d Lieutenant, A.N.C., had a final type physical examination for extended active duty on Dec. 7, 1942. On March 6, 1943, she reported to this hospital for extended active military service and a routine x-ray film of the chest was made. This revealed mottled parenchymal infiltrations in the right upper lung field in the anterior portion of the first interspace. Fibrotic strands



Figs. 9 and 10. Case IV. Figure 9 (above) is a lordotic view disclosing an exudative lesion underlying the first anterior rib and clavicle, as shown also in Figure 8.

Figure 10 (below) is a lordotic view taken six months after that in Figure 9. There is a definite increase in the exudative infiltration, indicative of activity. Routine postero-anterior projections failed to show any change over this period.

extended from the right hilum to this area (Fig. 1). A lordotic view revealed a circular field of increased translucency, approximately 8 mm. in diameter (Fig. 2). This was surrounded by a well defined annular shadow and undoubtedly represented a cavity. There were a few infiltrations in the left apex. Serial x-ray examination showed an increase of the exudative reaction in the right upper lobe.

It is to be noted that physical examination and laboratory data were negative. A roentgenogram of the chest made on Dec. 7, 1942, revealed no pulmonary lesion.

CASE II: C. M., 2d Lieutenant, A.N.C., aged 32, when examined by x-ray thirteen months after entry into the military service, was found to have an area of soft infiltration measuring 2×2 cm. in the



Figs. 11 and 12. Case V. Figure 11 (left) is the chest film made in November 1938, showing a 4-cm. cavity in the right lower lobe, surrounded by a moderate zone of reaction. Exudative lesions are seen about the right hemidiaphragm.

Figure 12 (right) is a film made three months after phrenic exeresis (three months later than Figure 11), showing elevation of the right hemidiaphragm and decrease in size of the cavity beneath the mid-portion of the 7th posterior rib.

right apical region. There was also a small rounded infiltrate in the mesial portion of the left apex. Small fibrocalcifications were present in the outer aspect of the second right interspace. The patient was hospitalized and her course was uneventful. All laboratory data were negative.

Previous x-ray studies were requested and films made on assignment to extended active duty revealed bilateral apical lesions (Fig. 3). These were fine, discrete, and fibrous in character. Comparison with our own films (Fig. 4) demonstrated definite activity and progression. Subsequent serial films and lordotic views (Fig. 5) during hospitalization of four months indicated that the lesion was quiescent.

CASE III: E. M., aged 23, 2d Lieutenant, A.N.C., had been examined roentgenographically twice a year since 1929, when it was discovered that her father had pulmonary tuberculosis. In 1938 she had pleurisy and was studied in a civilian sanatorium, and all tests were negative for tuberculosis. Subsequent roentgen studies were likewise negative. On interval examination, when she reported for duty at this hospital, films of the chest revealed several small calcified foci at the extreme left apex and many fibrotic infiltrations in the left first anterior interspace (Fig. 6). Subsequent serial roentgenograms showed the appearance of soft and fibrotic infiltrations in the left first anterior interspace, indicative of activity (Fig. 7).

CASE IV: W. M., aged 24, Staff Sergeant, had an x-ray examination for admission to Officers' Candidate School. This was considered unimpressive,

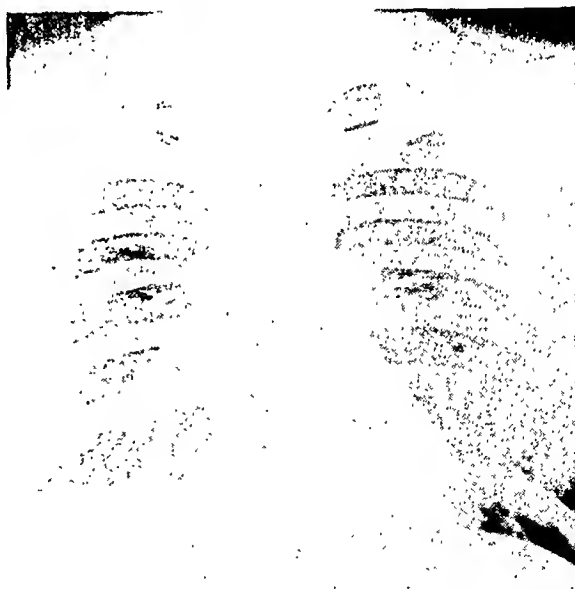


Fig. 13. Case V. Chest film made in September 1942. There is no evidence of cavitation. Tuberculous infiltrations have decreased markedly, but are present in the right lower lung field. There is also evidence of peribronchovascular fibrosis.

but because of increased markings in the left apex, a second roentgenogram was taken at the completion of his course. A lesion was demonstrated in the left upper lobe and the soldier was temporarily disqualified as an officer, but was returned to duty. Five

months later he was hospitalized for determination of activity. He was asymptomatic and physical examination was essentially negative. All laboratory data were negative. Chest films showed a minimal apical infiltration which was fibrotic in character (Fig. 8). This was better demonstrated in the lordotic view (Fig. 9). Serial examinations were made in a period of six months, during which time no apparent change had occurred. Lordotic views (Fig. 10) were again taken and demonstrated a definite increase in size of the lesions. This progression was merely suggested by an anteroposterior view. While this soldier had been asymptomatic, afebrile, and gained 15 lb. during hospitalization, x-ray studies had shown his lesion to be definitely active.

CASE V: B. B., aged 30, Corporal, felt well until April 1938, when, following an injury, he underwent an umbilectomy. Two months after operation he felt weak and listless and had lost 50 lb. in weight. A dry, hacking cough developed and profuse hemoptysis occurred. In August he was admitted to the Marine Hospital, where he was found to have a positive sputum. In view of the x-ray findings, a phrenic exeresis was done. The symptoms then subsided, the sputum remained negative, there was a gain of 40 lb., and the patient was discharged from the hospital, at his own request, within six months. He remained in good health and enlisted in the Army Air Corps on Sept. 12, 1940. No roentgenogram of the chest was made. He was assigned to clerical work and performed his duties without difficulty for two years. In August 1942, he was transferred to the Amphibian Command. With this change of work, he noticed fatigue and experienced a recurrence of cough and hemoptysis, for which he was hospitalized on Aug. 14, 1942. Physical examination revealed slight contraction of the right hemithorax and marked limitation, with flatness, absence of fremitus, and diminished breath sounds over the right lower lobe. The diaphragm was elevated and did not descend with inspiration. A chest film showed fibrotic infiltration of moderate extent in the mesial portion of the right apex. The right hilum was prominent and the lung markings in the right base showed evidence of peribronchial thickening. The right hemidiaphragm was 3 in. higher than the left and fluoroscopy showed a slight lag. Serial re-examinations showed no change. All other laboratory data were negative.

In view of the patient's medical history, films were requested from the Marine Hospital. These showed that in 1938 this soldier had had a large cavity, 4 cm. in diameter, in the right lower lobe (Fig. 11). This regressed rapidly after phrenic exeresis, but the lesion was still present (Fig. 12) and was evident on our own films (Fig. 13).

CASE VI: V. G., 2d Lieutenant, A.N.C., entered the Army on extended active duty Dec. 1, 1942. Three days later she had a final physical examination performed at this hospital. X-ray examination revealed a small, fibrous, discrete appearing lesion at

the extreme left apex (Fig. 14), and she was hospitalized for determination of activity. Physical examination was essentially negative. Serial films were taken at intervals of one week and within a period of fourteen days the infiltration had completely disappeared (Fig. 15). In this case, initial x-ray studies demonstrated what was considered a typical tuberculous infiltration but subsequently was proved to be a non-tuberculous lesion.

CASE VII: J. M., aged 49, Lieutenant Colonel, felt well until October 1942, when, while on maneuvers in Tennessee, he experienced a chill and a slight cough and was hospitalized for a primary atypical pneumonia. Within fifteen days he was discharged to duty. He then went to General Staff School in Leavenworth and felt well until Dec. 26, 1942, when he experienced generalized polyarthralgia, chills, and fever of 102°. He did not improve and was admitted to the Station Hospital for further treatment.

Inspection was essentially negative except for a healed thoracotomy scar on the left axillary line, the result of a suppurative pleurisy in childhood. Examination of the lungs revealed dullness over the left upper lobe; fremitus was decreased in this area. The breath sounds were bronchovesicular and distant in character. Fine, infrequent crackling râles were audible along the medial border of the left scapula.

Chest films (Fig. 17) revealed a diffuse fibrotic area of infiltration in the region of the left apex, extending down to the 6th rib posteriorly. Within this area were many small translucencies suggestive of cavities. There was a fibrotic infiltration in the right infraclavicular area. The picture was consistent with a chronic fibrocaceous pulmonary tuberculosis. Subsequent serial films (Fig. 18), however, over a period of five months, revealed a slow but progressive resolution of the infiltrations previously reported. In view of these findings, the diagnosis of chronic fibrocaceous tuberculosis was less tenable. Subsequent examinations (Fig. 19) showed further resolution until complete clearance had occurred. This case of primary atypical pneumonia illustrates the difficulty encountered in differential diagnosis, for the chest lesions cleared only after an observation period of nine months.

COMMENT

The plea for routine periodic x-ray examination of the lungs had its counterpart years ago when those interested in public health made a concerted effort to popularize periodic health examinations. The results of many surveys of isolated groups gave abundant evidence that an appreciable percentage of supposedly well people had unsuspected illnesses which were either preventable or could have been detected



Figs. 14 and 15. Case VI (asymptomatic). Figure 14 (left) is a routine chest film taken Dec. 10, 1942. A discrete fibrotic appearing lesion is present in the extreme left apex. This was considered to be tuberculous. Figure 15 (right) is a film taken two weeks later, showing complete resolution of the lesion. This was confirmed by subsequent postero-anterior and lordotic views of the chest.

at their inception by careful and intelligent physical examination. That regular physical examinations, frequently repeated, could prevent suffering, promote longevity, and check the advance of progressive illnesses was generally appreciated by the medical profession. Insurance companies have stressed the importance of annual urinalyses for their policy holders. The impressive saving of lives among infants and children had its beginning and owes its success to this important phase of health education. No longer is expense an insuperable factor in procuring such services, since they are available in every walk of life.

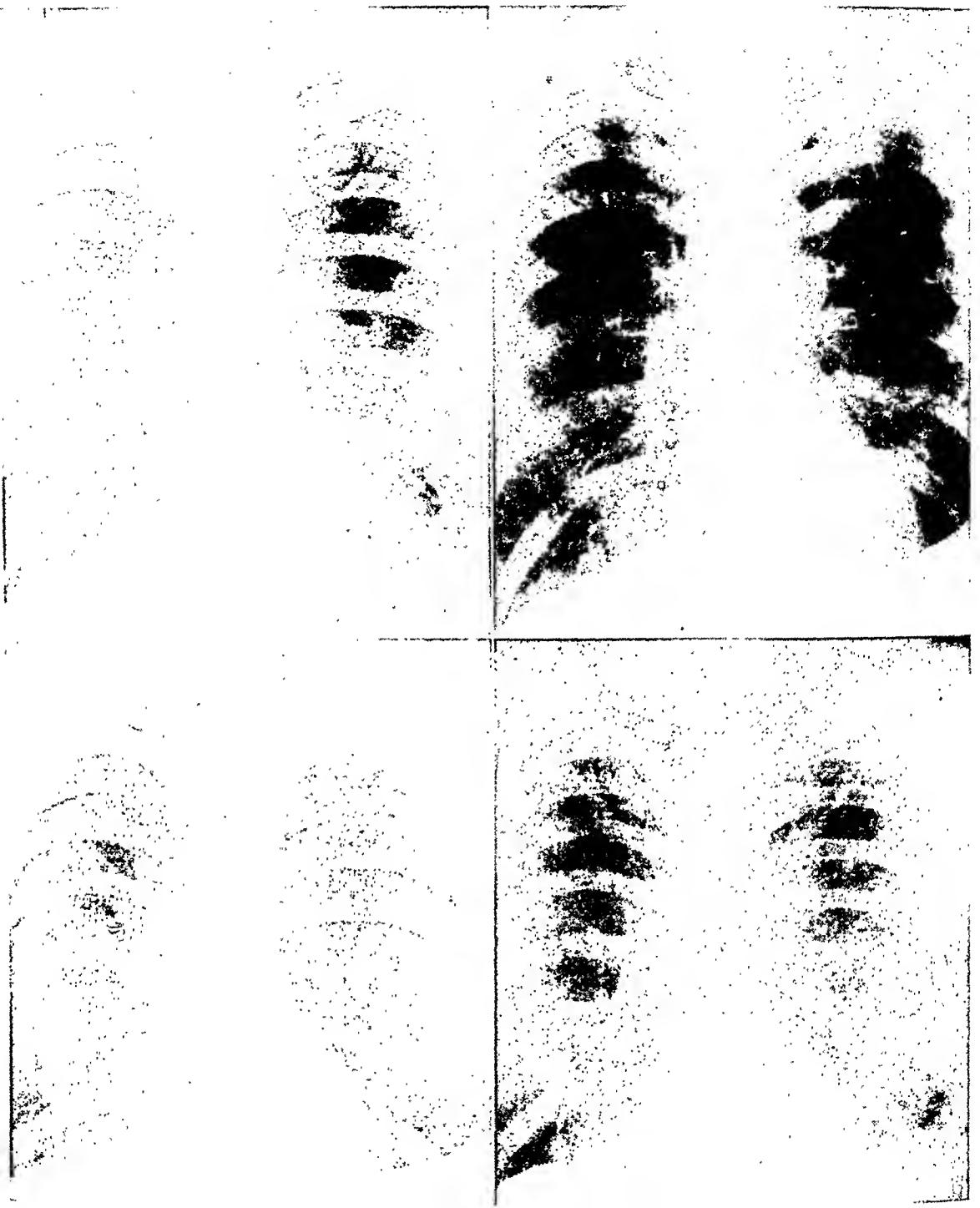
The difficulty of detecting early manifestations of pulmonary tuberculosis, more especially in the young, discouraged pioneers in this work, for only a small number of active early lesions were disclosed in various surveys. It was only after the importance of x-ray examination of the chest came to be recognized as the most reliable method of detecting the disease in its incipency that significant progress was noted.

Minimal infiltrations of pulmonary tu-

berculosis may be suspected by a highly skilled examiner. It is doubtful, however, if this amounts to a definite conviction *without the aid of the x-ray*, except in a negligible number of instances. It is important that this phase of the subject be thoroughly appreciated. Nothing is more vital in dealing with this disease which still claims, unnecessarily, a large number of lives.

The final proof that x-ray examination is the only sure method of diagnosing early tuberculosis came with the routine examination of selectees for the Army. Films are also made prior to discharge from the Armed Forces for any cause. Thousands of medical officers appreciate this important advance in medical care. Induction films or those taken at other hospitals are gathered together for study whenever a suspicious pulmonary lesion is noted. Progression, regression, or the static nature of the lesion is appraised, new deposits are detected, and patients are retained for a sufficiently long period to establish a diagnosis.

"Mass roentgenography of itself cannot



Figs. 16-19. Case VII. Figure 16 (upper left) is the film taken for extended active duty, showing obliteration of the left costophrenic angle and adhesions to the left hemidiaphragm, the residuals of an old suppurative pleurisy. Chest otherwise negative.

Figure 17 (upper right) is the film made Jan. 2, 1943, five days after hospitalization. There are diffuse fibrotic appearing infiltrations in the region of the left apex, extending down to the 6th posterior rib. Many translucencies in this area are suggestive of cavitation. Fibrotic infiltrations are seen in the right infraclavicular area.

Figure 18 (lower left) is the film made in March 1943, showing resolution of the pneumonic process. Fibrotic appearing lesions are still present in the left apex, extending down to 4th posterior rib. Right lung infiltrations show little change.

Figure 19 (lower right), April 1943, shows the lesions previously noted to have almost completely disappeared. The picture is similar to that in Figure 16. Progressive resolution demonstrable in the serial films favored a diagnosis of atypical pneumonia.

be relied on for the diagnosis of tuberculosis and a negative finding is no guarantee that at some time the disease will not become apparent. It will, however, pick out subjects for further intensive investigation" (21). Almost all Army personnel have now had roentgen chest examinations. This personnel cannot, however, be considered to be free of pulmonary conditions indefinitely. Subsequent studies should be made. Only in this manner can small minimal, asymptomatic, tuberculous lesions be demonstrated and the patient be given the proper medical attention.

The present report, covering a relatively small number of patients is indicative of the soundness of this procedure. Not only in those having illnesses referable to the lungs, but in various services in the hospital, these early lesions have come to light. That error in technical procedure or enthusiasm in interpretation may not be subject to criticism is borne out significantly by the subsequent laboratory evidence. In the majority of instances, an account of minor weight loss, easy fatigue, and vagaries of appetite has been elicited in careful history taking. The great importance both to the individual and his comrades of detecting this insidious contagious disease in its very beginning cannot be overemphasized. Starting the sick patient on the latest approved treatment facilitates his recovery as well as reducing the number of days of suffering.

Mass chest roentgenography is the most impressive advance in the control of tuberculosis since the discovery of the offending organism.

SUMMARY

1. Roentgen examinations of the chest offer the best present method for detecting small minimal tuberculous lesions.

2. Induction films furnish a permanent and authoritative record which is useful in subsequent medical study.

3. Military service may activate latent or active foci, through fatigue, worry, lowered resistance, and irregular hours incident to training or combat.

4. Twenty-three patients, or 21.3 per cent of those admitted directly to the tuberculosis section of the Lovell General Hospital, were hospitalized solely because of the findings on routine roentgen examination of the chest. Eleven of these cases were subsequently proved active. In 6 of the 11 activity was proved only by regressive or progressive changes on serial x-ray examinations of the chest.

5. For 21 patients induction films were available from the Veterans Bureau or civilian hospitals. In 20 instances, tuberculous lesions were found to have been present at the time of entry into the Army. The 21st patient developed pulmonary tuberculosis nine months after induction. In 11 of the 20 cases the tuberculous lesions were overlooked at the time of induction. Four patients were considered "acceptable under MR 1-9" and of these 2 proved to have active lesions. In 5 patients the evidence was obtained from previous sanatorium films.

6. Lordotic views are helpful, giving increased visibility of cavities and other processes in the apices of the lungs. The procedure is simple, entails no additional expense, and should be resorted to more frequently in the examination of apical lesions.

7. Atypical pneumonias account for the majority of mistaken admissions for tuberculosis, and their differential diagnosis is difficult.

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Roentgenologic Aspects of Retroperitoneal Perforations of the Duodenum¹

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MOST PERFORATIONS of the duodenum occur into the free abdominal cavity and produce widespread contamination of the peritoneum. The signs and symptoms are well known and the diagnosis is promptly established. Early treatment has resulted in a surprisingly low mortality. In retroperitoneal perforations the reverse is true. The same area is involved and the same duodenal contents escape through the rent in the wall. Nevertheless, the mortality remains at 90 per cent. While the technical difficulties of repair and drainage are admittedly a factor, this high mortality is largely due to errors in diagnosis and procrastination in treatment. Any improvement in the accuracy and promptness of diagnosis should surely reflect a reduction in the mortality.

ETIOLOGY

Although many retroperitoneal perforations of the duodenum occur as complications of peptic ulcer, the majority are due to trauma. In spite of its well protected anatomical location, about 10 per cent of all traumatic ruptures of the gastrointestinal tract occur in this part of the bowel, one-third of them in its retroperitoneal portion. Occasionally they are multiple and perforate intraperitoneally and retroperitoneally at the same time.

Most of these injuries involving the duodenum are of the blunt type; they are believed to occur in one of three ways, namely, crushing of the bowel between the blunt force and the spine, bursting of a distended loop the ends of which are momentarily closed, and tearing at a region of fixed ligamentous attachment. Most of the cases reported have been due to such injuries as kicks or blows in the ab-

domen, crushing between heavy objects, or being run over by a vehicle. Compound injuries, in which there is a communication with the outside, will not be considered.

CLINICAL FEATURES

The clinical features are especially important. Unless the attending physician bears in mind the possibility of a retroperitoneal perforation, the hope of an early diagnosis is lost. This is especially true in traumatic cases. It is a striking observation that comparatively few patients are greatly inconvenienced by the original trauma. Only a few vomit immediately, and the pain is in no sense severe. Many are able to walk following the injury. Few are unconscious. It is only upon the advent of the effects of the extravasation that the symptoms become marked. This is the reverse of intraperitoneal perforations. Rigidity is not a prominent symptom and when it develops, usually after several hours, it means that communication with the free abdominal cavity has occurred and peritonitis is developing. Laparotomy at this stage will reveal the hopelessness of the situation. The extravasated material, consisting of blood, bile, pancreatic juice, and other duodenal contents, is doubtless infected by this time and will have produced retroperitoneal cellulitis and necrosis. Peritonitis produced by such material cannot be expected to respond to treatment. It is important, therefore, that the early symptoms be ascribed to the underlying lesion and not to a contusion of the abdominal wall or a blow to the "solar plexus." It must be remembered that relatively minor injuries to the abdomen may rupture the bowel and that severe injuries may leave no visible marks of violence.

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ROENTGENOLOGIC ASPECTS

The use of barium or bismuth salts in the roentgen diagnosis of any acute perforation of the gastro-intestinal tract is contraindicated. The diagnosis must depend on the demonstration of air that has escaped from the hollow viscus through the opening in the wall into the tissues or free into the abdominal cavity. The atmosphere as the source of this air must be excluded. Consequently, roentgenograms in cases of puncture wounds, bullet wounds, surgical accidents, etc., where the skin is broken, can have no value except in the demonstration of fractures or injuries to solid organs. In retroperitoneal perforations, the diagnosis depends on clinical or roentgenographic evidence of emphysema. This may become rather extensive in a short time depending on the rate of passage of air through the rent in the wall. Considerable crepitus has been encountered in patients surgically explored within an hour from the time of the injury. It may extend as far as the subcutaneous tissues of the neck and has been elicited on rectal examination. As a rule, considerable time is required before it can be observed clinically. The emphysema, of course, is significant only in that extravasation of other contents of the duodenum is implied.

It has been stated that over 90 per cent of the traumatic retroperitoneal perforations of the duodenum occur in the second and third portions. In most instances, therefore, the distribution of emphysema should be consistent. According to Miller (1), the findings at operation are distinct and practically pathognomonic. The extravasated blood and duodenal contents are nearly always found either in the root of the transverse mesocolon, in the root of the mesentery of the small bowel, or both, and in the intervening retroperitoneal space, very often extending somewhat to the right over the kidney. The tumor is usually crepitant, since it contains gas. Despite this almost pathognomonic appearance, in one-third of the cases studied

by Miller the lesion was not recognized at operation, although this was undertaken on a diagnosis of probable rupture of the bowel.

The course of the extravasated material may occasionally vary. Maddock (2) reported a case in which the suppurative process traveled laterally along the ribs, producing an abscess in the liver which pointed toward the lower axilla. In a case published by Keller (3) there were, as well as widespread retroperitoneal extravasation, purulent mediastinitis and pleurisy. Petren (4) recorded 4 cases of retroperitoneal perforation of ulcers of the second and third portions of the duodenum. He stated that the retroperitoneal inflammatory process may pass to the right kidney region and point anywhere between here and Poupart's ligament; it may extend to the left in a similar manner, or may spread along the large vessels up through the diaphragm to the mediastinum.

In the literature available to us, only three instances in which the diagnosis of retroperitoneal perforation of the duodenum was made by x-ray were found. Sperling and Rigler (5) reported the first case in 1937. Their patient was kicked in the abdomen by a horse. Roentgenograms made twenty-four hours later revealed the presence of gas about the right kidney, the right psoas muscle, and retrocecal region. There was no free air in the peritoneal cavity. Recovery followed conservative treatment without operation. Serial films showed a gradual diminution of the emphysema over a period of three weeks. Barium studies five months later revealed a deformity in the second portion of the duodenum in the region of the rupture.

The second case was reported by Ottenheimer and Gilman (6) in 1940. A student diver misjudged his distance and scraped his right anterior chest and abdomen on the springboard. In spite of severe pain and shock, he was able to get out of the pool with assistance. A leukocytosis of 22,000 cells (90 per cent polymorphonu-

clears) developed within two hours. Scout films of the abdomen showed considerable air in the retroperitoneal tissues surrounding the kidneys and along the psoas muscle. Operation within three hours from the time of injury revealed no evidence of serious intraperitoneal trauma or perforation. Crepitus was noted beneath the serosa of the lower part of the ascending colon, cecum, and terminal ileum, and in the mesentery of the terminal ileum. Lateral to the cecum and ascending colon there was extensive emphysema. The air was believed to have originated from the injury to the chest. The patient died thirty-eight hours later, and the source was proved to be a large retroperitoneal perforation of the duodenum at the junction of the second and third portions.

The third case is that of Somogyi (7), reported in 1941. His patient was suspected of having a perforated peptic ulcer and was examined roentgenographically for evidence of free air in the abdomen. None was detected, and the examination was repeated about five or six hours later. At this time a streak of air was observed surrounding the right kidney and extending downward retroperitoneally between the psoas muscle and the ascending colon.

In the course of the search for the origin of the emphysema, an oral contrast meal was administered and leakage was demonstrated from the posterior wall of the first portion of the duodenum into the retroperitoneal tissues. The patient ultimately died and the perforated ulcer was confirmed by autopsy.

Retroperitoneal perforations of the duodenum have been reported innumerable times. Most of the patients have shown emphysema at some time or other, usually in the location described by Miller. Eighteen out of 22 of his own cases showed crepitus. It is strange, indeed, that in spite of the frequency of the emphysema and the consistency of its location, the diagnosis by x-ray has been so rarely reported. It is significant that the roentgenographic appearance of the three cases cited above was so strikingly similar.

CASE REPORTS

The following two cases, we feel, are interesting and instructive. Unlike the vast majority of reported traumatic retroperitoneal perforations of the duodenum, each was the result of a blow in the back rather than in the abdomen. One patient was able to walk immediately after the injury; the other certainly would have been able to do so except for the cerebral concussion sustained at the same time.

CASE I: While unloading metal plate, a 50-year-old colored male was forced against a box car, injuring his right lower back. He complained only moderately of localized pain and tenderness. Although he could walk about without much distress, he was unable to continue working and was taken to his home. The pain gradually increased in intensity and later in the evening he vomited some fluid material but no blood. No improvement occurred during the night, and the next morning the man was admitted to the hospital by wheelchair. At this time his temperature was 102°, pulse 112 and of poor quality, respiration 32, and blood pressure 75/58. His blood count revealed 12,650 leukocytes, with a definite shift to the left. Examination of the urine showed albumin 1 plus and 25 to 50 red blood cells.

The patient was lethargic in mental response but was restless in bed. A firm, moderately tender mass five inches long and one inch wide was palpated in the right costal arch posteriorly. The abdomen was distended and the right flank was moderately swollen and tender. There was slight rigidity of the right abdominal wall. Treatment consisted in continuous duodenal drainage, sulfadiazine, and parenteral fluids. Uremia gradually developed and death occurred on the sixth day in the hospital.

Scout films of the abdomen taken the day after admission revealed linear fractures of both twelfth ribs about two inches from the spine. There was no evidence of free air or emphysema.

The clinical diagnosis was possible subcapsular or perirenal hemorrhage and possible perforation of the ascending colon.

Autopsy revealed an acute perforation of the anterior wall of the third portion of the duodenum leading directly into the root of the mesentery, with the formation of a huge, fetid, dissecting retroperitoneal phlegmon extending across the mid-line of the abdomen and surrounding the right kidney in the perinephritic fat tissue. It also dissected inferiorly from this region into the iliopsoas muscles, which were the seat of a fetid myositis, extending downward to the brim of the bony pelvis. The posterior parietal peritoneum on the right side was markedly displaced anteriorly. There was no evidence of a generalized peritonitis. The patient



Fig. 1. Case II. Supine films of the chest and upper abdomen showing the fracture of the eleventh rib on the left and the streak of air (arrows) extending along the left side of the spine through the diaphragm to the inferior mediastinum and along the left leaf of the diaphragm.



Fig. 2. Case II. Right decubitus position. The location of the air streal remains the same.

also had a typical chronic peptic ulcer measuring 1.0 cm. in diameter, located in the superior wall of the cap and extending about 3.0 mm. in depth into the wall of the duodenum. There was no evidence of interstitial emphysema.

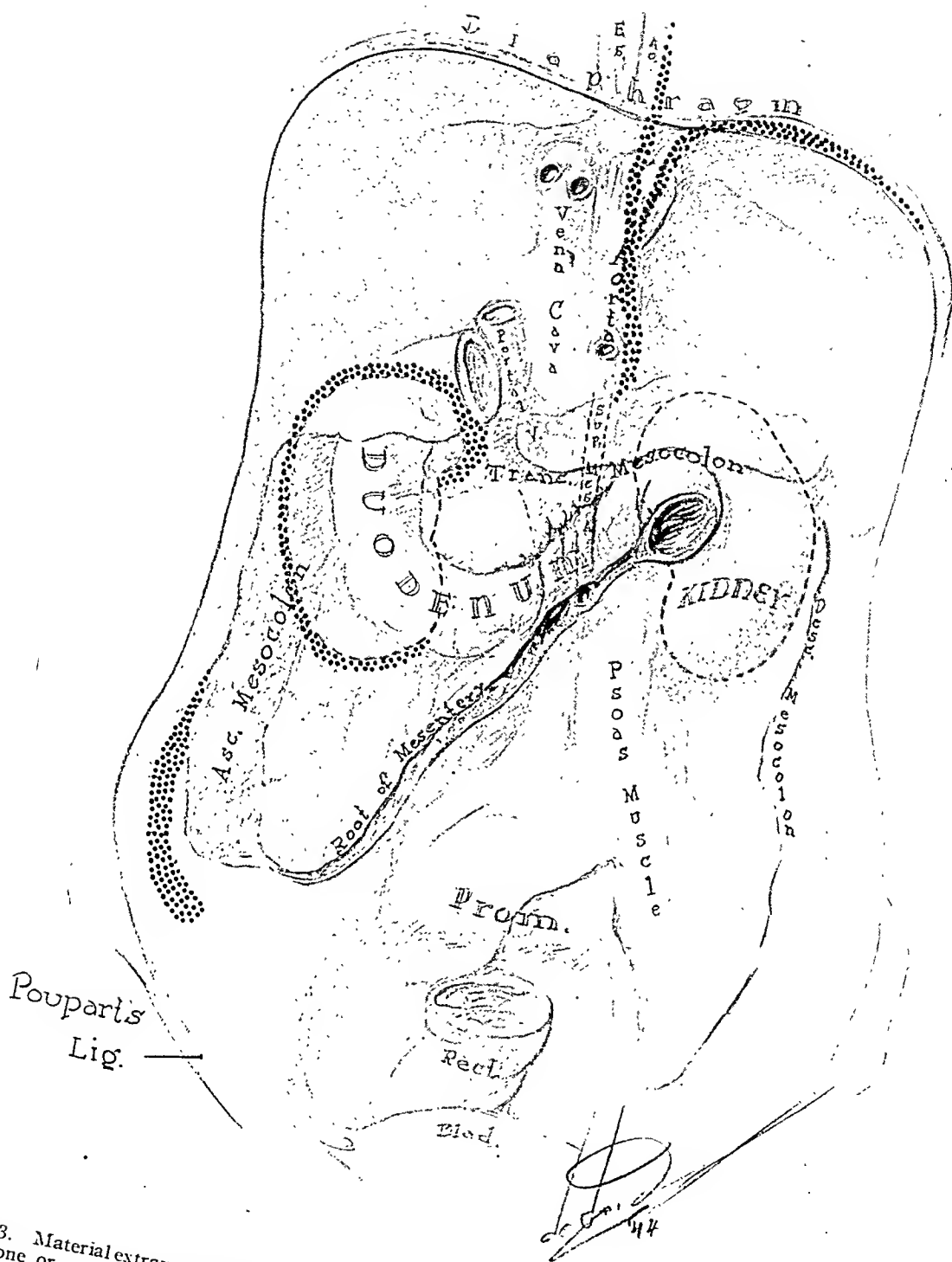
Comment: The absence of crepitus explains why the scout film examination in this case was of no value. It has been estimated that emphysema should be present in over 80 per cent of these cases. Had it been present, the films would have demonstrated it to be in the location described by Miller and demonstrated radiographically by Sperling and Rigler, Ottenheimer and Gilman, and Somogyi.

CASE II: A 46-year-old Italian laborer was struck in the left side of the back at about the level of the diaphragm by an overhead crane and was crushed against a wall. He fell to the floor and struck his head, causing a laceration of the scalp, contusion of the right eye, and a cerebral concussion. He was given first aid and brought to the hospital. X-ray examination revealed a linear fracture of the eleventh rib on the left side, 2 inches from the spine. A streak of air was noted extending along the left side of the spine (Figs. 1 and 2) through the diaphragm, presumably along the great vessels, to the

inferior mediastinum. Another streak of air branched off from this and extended along the left leaf of the diaphragm, apparently between the muscle and the parietal peritoneum. This appearance did not change with shift of position of the patient. There was no roentgen evidence of injury to the lungs or pleura. Our impression was that the air must have originated from a retroperitoneal perforation of a viscus, probably the third or fourth portion of the duodenum.

Clinically this patient was not very ill at any time. His chief complaint was abdominal distention and pain in the region of his fractured rib, which was referred (probably due to diaphragmatic irritation) to his left shoulder and arm. He ran a temperature of 101° for four days; the white blood count rose from 8,700 to 11,650 and fell to 6,750 on the fourteenth day in the hospital. A chest film taken on the seventh day showed no evidence of emphysema. Treatment was conservative, and the patient was discharged as improved on the fifteenth day.

Comment: This patient recovered without surgery, and the diagnosis, therefore, could not be proved beyond doubt. Nevertheless, we believe that a retroperitoneal perforation of the duodenum occurred and that the case represents one of the possible



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Fig. 3. Material extravasated through a retroperitoneal perforation of the duodenum will tend to extend along one or several of the following courses, depending on the location and duration of the perforation: (1) along the root of the transverse mesocolon; (2) along the root of the mesentery of the small bowel; (3) along both and in the intervening space; (4) over the right (rarely the left) kidney; (5) downward along the root of the mesentery of the ascending colon and cecum (clinically this may simulate and occasionally has been diagnosed as appendicitis or appendiceal abscess); (6) downward along the psoas muscle to the brim of the bony pelvis or to Poupart's ligament, simulating a psoas abscess; (7) along the great vessels through the diaphragm into the inferior mediastinum.

courses of the extravasated material (in this case chiefly air). Petren (4) and others have mentioned this path along the great vessels through the diaphragm to the mediastinum. Neither does the fact that the patient recovered without operation alter our opinion. Most surgeons have observed recovery in cases of perforation of a hollow viscus where surgery has been refused. Ravdin (8) expressed the opinion that the time of operation is not so important as what is happening to the patient. The content of the viscus at the time of perforation is most important. Barber and Madden (9) used elective conservative therapy in 5 cases of proved intraperitoneal perforation with no deaths.

DISCUSSION

The roentgenographic diagnosis of retroperitoneal perforation of the duodenum should not be difficult in most instances. Good films are important and proper positioning is imperative. Films of the abdomen should be made with the patient in the supine, the upright, the left lateral decubitus, and the lateral positions. From the standpoint of safety and accurate roentgen diagnosis, the patient suspected of having a perforated viscus should be advised to lie on his left side so that air rather than contents would escape through the perforation. In the event that the examination is negative, it may be repeated after a few hours unless immediate surgical intervention is indicated. Stereoscopic films may assist in localization of the emphysema. Examination of the patient in various positions must be carried out to determine whether the air is fixed in the tissues or free in the abdominal cavity or both.

While, as stated above, most retroperitoneal perforations of the duodenum are the result of trauma, peptic ulcers may gradually perforate posteriorly into preformed adhesions, the pancreas, colon, or some other viscus. These may heal spontaneously and disappear or may result in abscess or fistula formation. They are usually discovered during barium studies

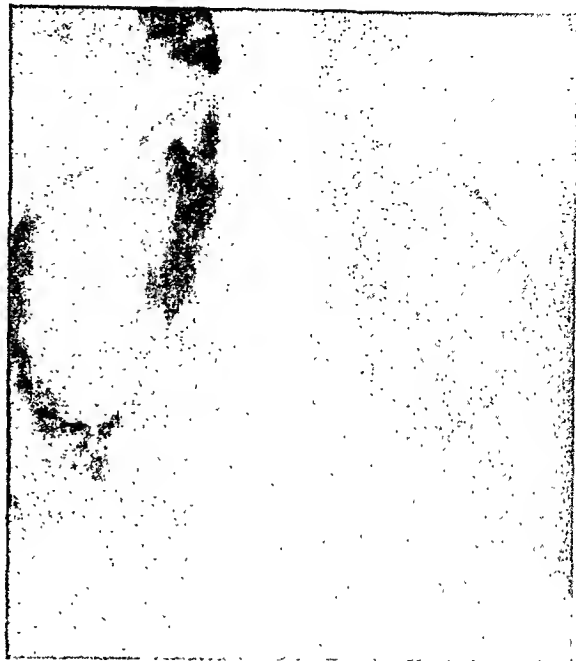


Fig. 4. Perirenal helium injection. The retroperitoneal distribution of the gas is similar to that of duodenal origin. The tendency of the gas to extend along the vessels, through the diaphragm to the inferior mediastinum, can be noted.

of the gastro-intestinal tract and are not within the scope of this communication. However, those acute, retroperitoneally perforating ulcers of the duodenum, especially of the second or third portions, must be included in the discussion of perforations due to trauma. The clinical and roentgen findings are essentially the same. Only the history of trauma is absent.

The scarcity of reported cases of retroperitoneal perforation in which the roentgen appearance has been described necessitates the use of operative and postmortem material in formulating what may be described as rather typical roentgenologic findings. It would seem from the roentgenographic point of view that the emphysema would tend to follow one or several courses. Figure 3 is intended as an anatomical review of the relations of the duodenum to the retroperitoneal structures and to depict the paths of the extravasated material.

If the point of extravasation is not closed by nature or repaired surgically, the material will accumulate in the retroperitoneal tissues. The result will be a combination

of several of the above courses, as described in the pathological report in Case I. The lateral film may be most important in the demonstration of emphysema in early cases where it is confined to the roots of the mesentery.

Figure 4 is a film of a perirenal helium injection and is presented only because of its similarity to retroperitoneal emphysema of duodenal origin surrounding the kidneys. The tendency of the gas to spread along the vessels through the diaphragm to the inferior mediastinum can be noted.

Differential Diagnosis: Free air in the abdomen, whether due to perforation of a hollow viscus, recent surgical operation, a tubal patency test, or any other cause, may give rise to emphysema of the extraperitoneal tissues. The exact mode of entry of the air is not always clear. A parietal peritoneum broken by trauma or surgery or damaged by infection may allow permeation of the pneumoperitoneum even to the subcutaneous tissues, where it can be palpated clinically. McCorkle and Stevenson (10) in 1937 reported an excellent example of this. In a patient with an intraperitoneal perforation of an anterior wall duodenal ulcer there developed a marked pneumoperitoneum and an extensive emphysema extending up the chest wall to the axillae, shoulders, upper arms, and neck.

Another mechanism of subcutaneous emphysema was described by Vigyázó (11), who in 1926 reported a case in which a callous ulcer on the anterior wall of the duodenum perforated and emphysema was noted around the umbilicus. He felt that the most likely path of the extravasated air was subserously along the duodenohepatic and round ligaments to the umbilical area.

These are examples of subcutaneous emphysema and, while they are confusing, they are rare and can usually be differentiated from the retroperitoneal air seen in duodenal perforations. Scout films of the abdomen would show the emphysema to be subcutaneous and confined more to the anterior and lateral walls.

Other cases have been reported in which gastric ulcers located near the cardia have perforated directly into the mediastinum, giving rise to emphysema in that region.

Perforations of the portions of the colon not covered by peritoneum, whether due to benign or malignant ulcerations or trauma, may give rise to retroperitoneal emphysema. Unless the perforation occurs in the right half, however, it should not be confused with a retroperitoneal perforation of the duodenum. In the presence of the emphysema, barium enemata are contraindicated.

Perforations of the duodenum into neighboring solid organs or the biliary tract would not be expected to present a confusing picture.

Another important condition which must be differentiated from extraperitoneal extravasation of gas is the localized pneumoperitoneum sometimes observed in instances of perforation of the small bowel distal to the duodenum. Most authorities agree that a small amount of air is extravasated in practically all perforations of the small intestine. When this occurs in the upper jejunum, the air tends to rise behind the omentum up to the transverse mesocolon, where it becomes loculated. Radiographically it usually appears as an irregular area of decreased density to the left of the second lumbar vertebra. Massie (12) described a case in 1924 in which a diagnosis was made on this appearance. At operation the duodenojejunal junction was found to be completely severed. Recovery followed repair of the injury. This diagnostic sign becomes especially important when it is realized that the majority of ruptures of the small bowel occur in the upper jejunum. The radiologist must be familiar with these irregular areas of localized pneumoperitoneum, interpret them accordingly, and not confuse them with air within a viscus or in the retroperitoneal tissues.

SUMMARY AND CONCLUSION

1. The great majority of retroperitoneal perforations of the duodenum are due

to trauma and usually occur in the second or third portion.

2. The mortality is extremely high, approximately 90 per cent. Death is due to retroperitoneal cellulitis, which in most instances eventually communicates with the free peritoneal cavity.

3. Early clinical diagnosis is rare and the institution of treatment usually delayed.

4. Retroperitoneal perforations of the duodenum have been reported in the literature scores of times. Emphysema was noted, either clinically or at operation or autopsy, in approximately 80 per cent. In spite of this, the diagnosis by x-ray has been reported only three times.

5. Proper x-ray examination should, in most instances, render this difficult diagnosis a relatively easy one, possibly within an hour or two of the injury.

6. Paths of extension of the extravasated material are depicted.

7. Two cases with practically identical injuries are presented. The first was proved by postmortem examination but x-ray findings were negative. The second patient recovered without surgery and, while the diagnosis was not proved beyond doubt, highly suggestive radiographic evidence was present. It seems justifiable to record this case and to direct attention to

this sometimes neglected type of perforation.

NOTE: We wish to thank Dr. Leon J. Leahy of the Department of Surgery for permission to report these two cases from his surgical service.

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Dosage Table for Linear Radium Sources¹

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THE EXPRESSION of tissue dosage in terms of roentgens is becoming general in x-ray and radium therapy. For interstitial radium or radon sources, the literature contains data for several satisfactory methods of determining the minimum dose delivered within a volume implanted with needles or seeds in accordance with certain general principles. In the case of single linear sources, however, such as are commonly employed in the treatment of cervical and rectal cancer, information is not so accessible. The most generally used charts, those of Patterson and Parker (1), give the number of milligram-hours necessary to deliver 1,000 r_y at points in a plane perpendicular to the source at its mid-point, up to 3 cm. distance. For positions not in this central plane, or for greater distances, they are not helpful. Sievert (2) and Laurence (3) have presented extensive data, but in rather complicated mathematical forms. Mayneord and Honeyburne (4) have published a general method for drawing isodose curves around any particular linear source; this is also too involved for ready use in the radiological department. Wolf (5, 6) gives data for the dosage in roentgens per milligram-hour in a plane perpendicular to the implant at its end, for a wide range of lengths of source and distances from the radium. The advantage of having the data for the end rather than for the middle of the needle is that any implant can be considered a combination of two segments, and the doses along lines perpendicular to the source at any desired point can be obtained by choosing the segments so that their ends come at that point. For instance, doses along a line perpendicular to a 4-cm. needle at a point 1 cm. from either end would be obtained as the

sum of doses from a 3-cm. and a 1-cm. needle, the former containing three times as much radium as the latter.

For ready use in the radiological department, there appears to be a need for a more straightforward table, from which, within practical limits, doses for a given treatment can be read directly, not only along perpendiculars to the source at central or end-points, but anywhere in the vicinity. Such a table is presented herewith.

Some years ago the author published charts and tables giving relative doses at different distances on perpendiculars erected at different positions along the linear sources (7). This was prior to the general acceptance of the gamma roentgen as a dosage unit, but in order to obtain the values in roentgens it is necessary only to establish the dosage for some one particular source and position. This has been done by taking the dose from a point source at 1 cm. distance, filtered by 0.5 mm. Pt, as 8.4 r_y. The material is presented in Table I.

Doses are given in gamma roentgens per 100 mg.-hr., at various distances along perpendiculars to the sources, at 0.5-cm. intervals along their lengths, as indicated in Figure 1. Line A is always perpendicular at the mid-point, line B, 0.5 cm. out toward the end; line C, 1.0 cm. out, etc. Thus line B is at the end of a tube 1.0 cm. long, line D at the end of a tube 3.0 cm. long, etc. The data are carried out for lines beyond the ends of the sources, so that doses for two or three in tandem can be summed, for any position along the group.

Distances are measured from the central axis of the tube. The range of tube lengths is from 0.5 to 8.0 cm., by 0.5-cm. steps to 3.0 cm., and then by 1.0-cm. steps to 6.0 cm. Distances, tube lengths, and positions

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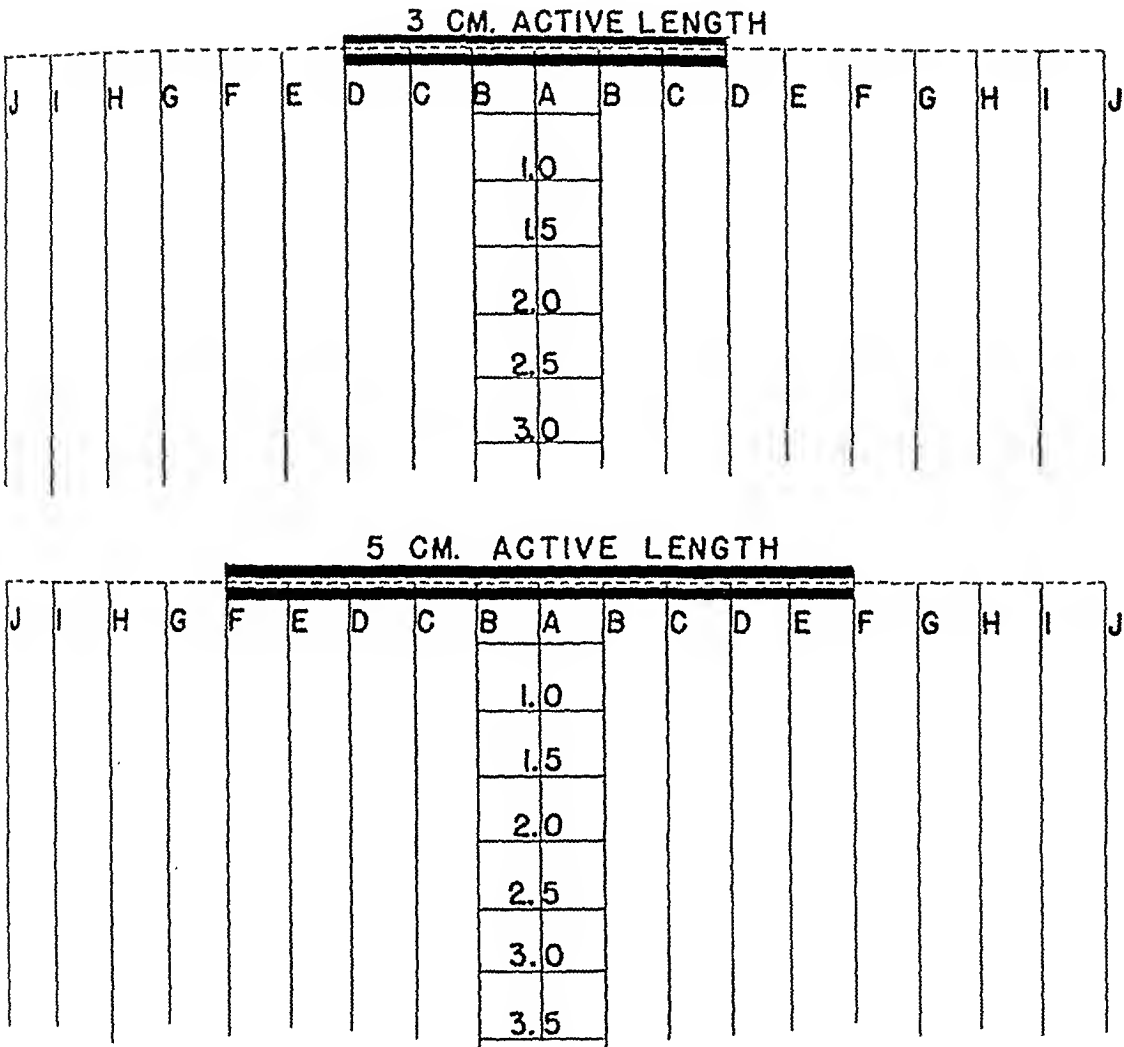


Fig. 1. Diagram showing relative positions of lines along which values are tabulated. The lines are 0.5 cm. apart.

of perpendicular planes not included in the table may safely be interpolated between the two nearest tabulated values.

No allowance is made for tissue absorption or scatter. It appears that within the first few centimeters these very nearly compensate for each other. At distances of several centimeters absorption may become appreciable; it is difficult to make proper allowance for it. Data in the literature indicate that it is probably of the order of 3 per cent per centimeter of soft tissue; hence, within distances of 3.0 or 4.0 cm., the error arising from neglecting such a correction should not be more than 10 per cent.

The table is for linear sources in which the active material is concentrated along

the axis of the source; no allowance is made for self-absorption in the salt, although it is realized that this may be considerable for positions very close to the ends of long needles. The filter is 0.5 mm. Pt. Allowance is made for the increase in filter when the rays emerge obliquely. If the filter is more than 0.5 mm. Pt, the doses will, of course, be less. The actual correction for increase in filter depends somewhat on the position of the point under consideration, that is, its distance from the source and whether or not it lies beyond the end of the source. By calculating the effect of additional filter for a series of representative points, however, it has been possible to establish satisfactory correction factors, applicable to most of the

TABLE I: GAMMA ROENTGENS PER 100 MG.-HR., DELIVERED AT VARIOUS DISTANCES FROM VARIOUS POINTS ALONG LINEAR RADIUM SOURCES (Filter 0.5 mm. Pt)

Cm. from Tube	Distance along Tube Axis: Cm. from Center										
	A Center	B 0.5	C 1.0	D 1.5	E 2.0	F 2.5	G 3.0	H 3.5	I 4.0	J 4.5	K 5.0
Tube 0.5 cm. long											
0.5	2,850	1,720	665	322	162	104	68	47	30	20	20
0.75	1,333	1,000	527	288	152	103	72	53	40	21	21
1.0	800	625	417	250	150	102	72	54	42	33	26
1.5	364	328	256	179	125	91	69	54	43	33	28
2.0	206	195	164	130	98	75	59	49	38	30	26
2.5	133	127	113	98	77	62	52	42	35	30	25
3.0	92	89	83	73	62	52	44	37	31	27	23
4.0	52	51	48	45	41	36	32	28	25	22	19
5.0	33	33	32	30	28	26	24	22	20	18	16
Tube 1.0 cm. long											
0.5	2,500	1,760	667	325	170	105	69	47	30	20	20
0.75	1,250	950	527	291	163	106	73	53	40	22	21
1.0	740	606	417	254	154	104	73	54	42	33	26
1.5	352	323	256	186	128	92	69	54	43	33	28
2.0	204	193	163	130	99	76	59	47	38	30	26
2.5	132	125	113	97	78	62	52	42	35	30	25
3.0	92	89	83	73	62	52	44	37	31	27	23
4.0	52	51	48	45	41	36	32	28	25	22	19
5.0	33	33	32	30	28	26	24	22	20	18	16
Tube 1.5 cm. long											
0.5	2,080	1,742	770	333	182	111	72	48	30	20	20
0.75	1,180	955	556	298	175	111	74	53	40	25	21
1.0	667	588	417	256	160	106	74	54	42	33	26
1.5	333	317	256	182	132	94	70	54	43	33	28
2.0	200	190	162	130	101	77	60	47	38	30	26
2.5	128	123	112	96	79	64	52	42	35	30	25
3.0	90	89	82	72	62	52	44	37	31	27	23
4.0	52	51	48	45	41	36	32	28	25	22	19
5.0	33	33	32	30	28	26	24	22	20	18	16
Tube 2.0 cm. long											
0.5	1,800	1,720	910	385	195	115	76	49	33	22	20
0.75	1,111	955	625	333	189	115	77	53	40	29	21
1.0	625	570	435	270	168	110	75	55	42	33	26
1.5	333	303	257	189	135	97	70	54	43	33	28
2.0	196	185	159	131	102	78	61	48	39	31	26
2.5	125	121	111	96	80	65	52	43	35	30	25
3.0	89	88	81	72	62	52	44	37	31	27	23
4.0	51	50	48	45	40	36	32	28	25	22	19
5.0	33	33	32	30	28	26	24	22	20	18	16
Tube 2.5 cm. long											
0.5	1,548	1,500	1,010	515	252	130	82	52	35	26	24
0.75	1,000	895	667	377	218	128	83	57	40	32	24
1.0	582	548	445	293	185	121	80	57	42	34	27
1.5	305	295	254	191	139	102	74	54	43	34	27
2.0	185	178	158	131	104	80	63	49	40	32	26
2.5	122	117	109	95	80	66	53	43	35	30	25
3.0	87	86	80	71	62	53	45	37	31	28	23
4.0	51	50	48	44	40	36	32	28	25	22	19
5.0	33	32	32	30	28	26	24	22	20	18	16

region about the implant. These factors are correct within plus or minus 5 per cent for all points within the region enclosed by perpendiculars from the ends of the source,

and for points outside that region except where they are 1.0 cm. or less from the axis of the needle, and farther beyond its end than half the length of the needle,

TABLE I: GAMMA ROENTGENS PER 100 MG.-HR., DELIVERED AT VARIOUS DISTANCES FROM VARIOUS POINTS ALONG LINEAR RADIUM SOURCES—Continued
(Filter 0.5 mm. Pt)

Cm. from Tube	Distance along Tube Axis: Cm. from Center										
	A Center	B 0.5	C 1.0	D 1.5	E 2.0	F 2.5	G 3.0	H 3.5	I 4.0	J 4.5	K 5.0
Tube 3.0 cm. long											
0.5	1,430	1,333	1,111	645	310	145	88	59	41	31	26
0.75	910	835	690	435	250	141	89	61	43	34	26
1.0	540	526	454	323	202	133	86	61	44	34	28
1.5	286	286	250	193	143	107	77	54	43	34	27
2.0	179	173	156	132	106	83	65	51	40	32	26
2.5	119	115	107	95	81	67	53	44	36	30	25
3.0	85	81	78	71	62	54	45	38	32	28	22
4.0	50	49	48	44	40	36	32	28	25	22	20
5.0	32	32	31	30	28	26	24	22	20	18	16
Tube 4.0 cm. long											
0.5	1,111	1,050	1,000	910	500	222	118	72	48	33	26
0.75	690	667	625	453	344	192	114	73	50	36	26
1.0	435	435	418	333	256	164	107	71	50	36	28
1.5	256	238	228	193	159	120	89	62	48	35	27
2.0	161	158	148	132	111	89	70	55	44	32	26
2.5	111	107	104	92	82	71	58	48	38	31	25
3.0	82	80	76	70	62	56	47	40	33	28	22
4.0	48	48	46	44	40	36	32	29	25	22	20
5.0	32	31	30	29	28	26	24	22	20	18	16
Tube 5.0 cm. long											
0.5	833	827	820	800	715	400	200	100	62	41	26
0.75	572	555	525	465	377	273	155	95	62	42	26
1.0	370	370	364	333	286	213	136	88	61	42	28
1.5	228	217	213	194	167	135	100	73	56	38	31
2.0	148	143	137	128	112	94	76	64	48	36	29
2.5	103	100	97	91	82	73	60	50	41	33	27
3.0	77	75	72	68	62	56	48	41	35	29	25
4.0	46	46	44	42	40	36	33	29	25	22	21
5.0	31	30	30	29	27	25	24	22	20	18	18
Tube 6.0 cm. long											
0.5	740	735	730	715	690	605	345	167	86	51	33
0.75	500	495	490	450	418	371	244	139	84	52	35
1.0	333	333	321	310	294	250	179	115	77	52	37
1.5	200	200	196	194	175	152	118	91	67	42	35
2.0	134	132	128	123	112	99	82	66	52	41	31
2.5	96	93	91	89	83	74	62	53	43	35	30
3.0	75	72	69	66	63	57	50	42	36	31	25
4.0	44	44	42	41	39	36	33	30	26	22	18
5.0	30	30	29	28	27	25	24	22	20	18	18
Tube 8.0 cm. long											
0.5	556	550	543	532	522	511	500	434	250	114	62
0.75	357	352	345	333	323	313	303	256	179	102	62
1.0	267	266	264	252	244	236	222	170	136	89	60
1.5	162	159	154	148	143	137	132	108	91	69	53
2.0	116	115	109	105	102	96	89	78	66	54	41
2.5	83	81	78	75	73	72	67	57	50	44	36
3.0	64	61	60	58	52	51	50	43	37	30	25
4.0	40	40	39	38	37	34	33	30	26	22	18
5.0	28	28	27	27	26	24	24	22	21	19	18

(e.g., at 1.0 cm. or less on or beyond line *D* for a 2.0-cm. tube, *G*, for a 4.0-cm., *J* for a 6.0-cm.). Within these limits, for 1.0 mm. Pt filter the gamma roentgens per 100

mg.-hr. are 90 per cent less than those tabulated; for 2.0 mm. Pt, 80 per cent less.

Some examples will serve to illustrate the use of the table:

(1) A cervix tandem consists of two capsules; the upper one contains 25 mg. radium and is 2.0 cm. in active length; the lower one contains 50 mg. of radium and is 3.0 cm. in active length; each is filtered by 0.5 mm. Pt. Between the active portions of the capsules is a space of 1.0 cm., including the ends of the tubes and the knot separating the two capsules in the rubber tubing holding the tandem. What is the dose at a distance of 2.0 cm. out from each end and from the middle of this applicator, if it is left in place for forty hours (for a total of 3,000 mg.-hr.)? In this period, the upper tube gives 1,000 mg.-hr., and the lower 2,000. The lower end of the tandem is 1.5 cm. below the center of the stronger tube and 5.0 cm. below the center of the weaker (Fig. 2). From the table it is found that at a distance of 2.0 cm. out along line *D*, 1.5 cm. from the mid-point of the 3.0-cm. tube (Point *X*, Fig. 2),

serted in the parametrium so that they lie approximately in an anteroposterior plane with the lower ends 0.5 cm. apart and the upper 1.0 cm. apart (Fig. 3). They are to be left in place 100 hours; hence each one supplies 300 mg.-hr. What is the dose midway between two needles at the upper end of the active portion, and 1.0 cm. outside the outer needle at the center (points *P* and *Q*)? Point *P* is 0.5 cm. from needles I and II, and 1.5 cm. from III, along lines perpendicular to their ends, or 1.5 cm. from their centers (line *D*). From the table, for 3.0-cm. needles, 100 mg.-hr. give 645 and 193 r_γ at 0.5 and 1.5 cm., respectively, along this line. Hence the dose at *A* is $(3 \times 645) \times 2 + (3 \times 193) = 4,449$ r_γ. At *Q*, the distance along perpendiculars at the centers of the needles, (line *A*) are 1.0, 1.75, and 2.5 cm., respectively. The value for 1.75 cm. must be found by interpolation between 1.5 and 2.0. The

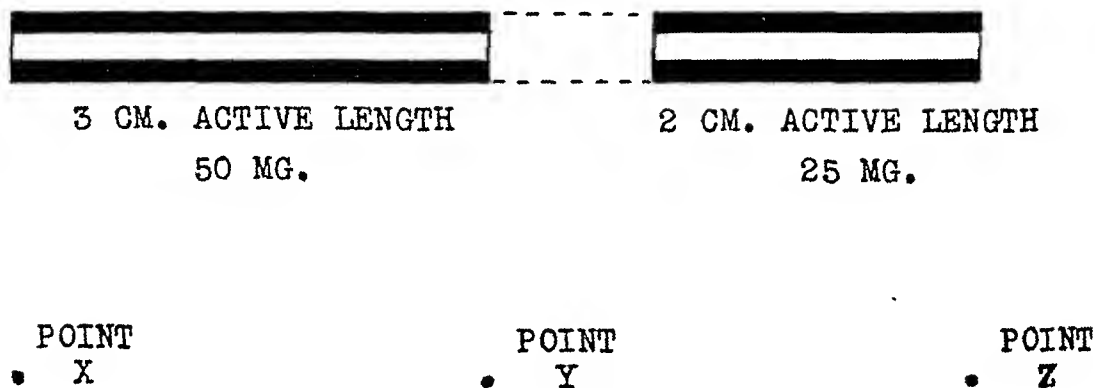


Fig. 2. Diagram of active portion of cervix tandem considered in Example 1.

100 mg.-hr. furnish a dose of 132 r_γ. Hence 2,000 mg.-hr. will give $(2,000/100) \times 132 = 2,640$ r_γ. At a distance of 2.0 cm. out along line *K*, 5.0 cm. from the center of a 2.0-cm. tube, 100 mg.-hr. give 26 r_γ, so that 1,000 mg.-hr. will supply 260, giving a total dose at this point of $2,640 + 260 = 2,900$ r_γ. Similarly, the dose opposite the center of the tandem, which is at the upper end of the strong tube (point *Y*), is the sum of those given by 2,000 mg.-hr. along line *D*, 1.5 cm. from the center of a 3.0 cm. tube, and 1,000 mg.-hr. along line *D*, 1.5 cm. from the center of a 2.0-cm. tube. At 2.0 cm. out from the radium along these lines, the doses are 132 r_γ and 131 r_γ, respectively, per mg.-hr.; accordingly the sum is $(20 \times 132) + (10 \times 131) = 3,950$ r_γ. In the same manner, the dose 2.0 cm. out from the upper end is found to be $(159 \times 10) + (32 \times 20) = 2,230$ r_γ. If the tandem had been considered a uniform source 6.0 cm. long, left in place for 3,000 mg.-hr., instead of the two different tubes specified, the doses at points *X*, *Y*, and *Z*, would have been 2,460, 4,020, and 2,460 r_γ, respectively. These are 18 per cent low for *X*, 2 per cent high for *Y* (negligible difference), and 11 per cent high for *Z*.

(2) Three needles, each having an active length of 3.0 cm., and a radium content of 3.0 mg., are in

dose is $(3 \times 540) + (3 \times 232) + (3 \times 119) = 2,673$ r_γ.

(3) A rectal lesion is to be treated by means of a radium applicator 6.0 cm. long, 2.0 cm. in diameter, with a total filtration equivalent to 2.0 mm. Pt. The lesion is about 1.0 cm. thick in its deepest region; the applicator is to be placed so that this comes as nearly as possible at the mid-point. The lesion extends upward for possibly 2.0 cm. more, where it may be 0.5 cm. thick. It is desired to give 4,000 r_γ to the deepest portion, and to know what dose will then be delivered at the upper margin. Since the applicator is 2.0 cm. in diameter, or 1.0 cm. in radius, the deepest part of the lesion, 1.0 cm. deep, lies 2.0 cm. from the radium, along a line at the mid-point of the applicator (line *A*). At this point, a 6.0-cm. source filtered by 0.5 mm. Pt. delivers 134 r_γ per 100 mg.-hr. The allowance for the extra filter reduces this to 80 per cent of 134, or 107 r_γ per 100 mg.-hr. To deliver 4,000 r_γ requires $(4,000/107) \times 100 = 3,750$ mg.-hr. The upper part of the lesion, 0.5 cm. thick, lies on a line 2.0 cm. from the mid-point (line *E*). Here 100 mg.-hr. gives 175 r_γ 1.5 cm. from the radium for 0.5 mm. Pt. or 140 for 2.0 mm. Pt. Hence, 3,700 mg.-hr. give 4,180 r_γ.

POINT P

POINT Q

Fig. 3. Diagram of parametrial needles considered in Example 2. Each needle has an active length of 3.0 cm., and radium content of 3.0 mg.

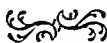
By methods illustrated by these examples, it is a simple matter to determine the dose delivered at any point within a reasonable range of any linear source (tube or needle) or simple combination of such sources, kept in place for any specified time. Conversely, the time necessary to deliver a certain dose at a specified point with such a source can be found. In general, such calculations are desirable for treatments of the types discussed

above. When a volume of tissue is more uniformly treated by needles in one or several planes, or by seeds, the dose desired is usually the minimum dose to the lesion, and this can more readily be found from the data published elsewhere for volume dosage (9, 10).

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Priodax: A Contrast Medium for Cholecystography¹

Analysis of 163 Cases, Outlining the Various Reactions in Three Technics and the Operative Findings in 22 Cases

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IN LESS THAN TWO decades cholecystography has been developed and has become an almost routine procedure for the study of suspected gallbladder disease. The accuracy of the procedure in determining the presence of a diseased gallbladder is about 95 per cent. This high percentage of accuracy adds emphasis to the clinical significance of such a study as well as the need for further refinement in technic.

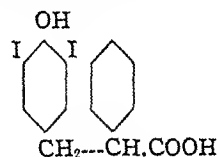
Since the original publication of Graham and Cole (3) describing a method of x-ray demonstration of the gallbladder by the intravenous injection of tetrabromphenolphthalein, roentgenologists, clinicians, physiologists, and chemists have worked to improve this method, using various chemicals and technics. Tetraiodophenolphthalein was discarded by Graham and Cole (4,5) in their original experiments because of its apparent toxicity. Further study proved these untoward reactions were due to impurities and could in great measure be eliminated by purification. In less than one year's time after the original publication, tetraiodophenolphthalein had replaced the tetrabromphenolphthalein, and it has been used almost exclusively up until the recent introduction of Priodax.

The first clinical reports on cholecystography with Priodax were from Germany, where it was known as Biliselectan, in 1940. Kleiber (8) reported 55 cases. Twenty-five of these did not show a gallbladder shadow. These cases were checked by the use of tetraiodophenolphthalein, with the same findings. Twenty-four of the positive cases were verified by surgical exploration, and gallstones were found in

all. The author concluded that Biliselectan was an excellent contrast medium for cholecystography and relatively free from side effects, such as nausea, diarrhea, and vomiting.

The conclusions of Kleiber were confirmed by other reports in the foreign literature (Lauer-Schmaltz, 9; Grunke and Finger, 6; Rittweger, 15; Naumann, 13; Rating, 14) and later in the American literature (Einsel and Einsel, 2; Wasch, 17; Marshall, 10).

Priodax chemically is a beta-(4-hydroxy-3,5 diiodophenyl) - alpha - phenyl-propionic acid with the following structural formula:



It is a white, odorless powder, soluble in alkali, ether, alcohol, and acetone, but almost insoluble in water. The sodium salt, however, is very soluble in water. Priodax contains 51.5 per cent iodine.

Experimental studies by Modell (12), with cats as subjects, showed that the intravenous injection of Biliselectan produced medullary convulsions. The lethal dose was approximately 150 mg. per kilogram body weight when given intravenously. Oral administration proved much less toxic, the lethal dose being as high as 1,000 mg. per kilogram body weight. Other toxic symptoms noted were impaired appetite, nausea, vomiting, and general depression. The emetic effect was shown to be due to local irritation of the gastrointestinal tract, since it did not occur with intravenous injections. Postmortem examination, however, did not reveal any evidence of intestinal irritation. Albuminuria was a constant finding, and in one

¹ From the Department of Radiology, Watts Hospital, Durham, N. C. Accepted for publication in March 1944.

TABLE I: SIDE EFFECTS OF PRIODAX
(163 Cases)

Method	None	Nausea	Diarrhea	Distress	Burning Sensation		
					Anus	Bladder	Throat
Double dose	14	21	39	9	13	11	4
Single dose	31	4	9	5	3	9	3
Divided dose	30	11	9	5	3	4	6

animal receiving 1,000 mg. per kilogram body weight there were venous congestion and parenchymatous degeneration of the kidney tubules.

Junkmann (7) found that during the first twenty-four hours after intake more than 50 per cent of Bilisclektan was excreted through the kidneys. In contrast with this, when tetraiodophenolphthalein is used, less than 10 per cent is excreted through the kidneys. The remaining portion of tetraiodophenolphthalein is eliminated through the gastro-intestinal tract, which is a highly undesirable feature, since the gallbladder is often obscured by the presence of the medium in the region of the hepatic flexure of the colon.

Priodax is supplied in tablets, each containing 0.5 gm. of the radiopaque substance. The manufacturers recommend 3.0 gm. as the average adult dose. If the dose is to be adjusted to body weight, as is necessary in children, one tablet for each 25 pounds of body weight is considered adequate. The tablets may be swallowed whole with sips of liquid, such as water or fruit juice. The tablets should not be chewed, since they produce an unpleasant burning sensation in the mouth.

MATERIAL

Our observations are based on 163 unselected, consecutive cases. Three methods of oral administration of the dye were used in order to arrive at a satisfactory routine procedure. The case distribution for the various technics was as follows: (1) double dose, 57; (2) divided dose, 55; (3) single dose, 51. The youngest patient was seventeen years old and the oldest eighty-two. There was a rather even distribution between these two extremes, as well as a fairly even sex distribution.

TECHNIC

For the double dose administration the patient was given the following instructions. At noon on the day before the x-ray examination, eat a large meal and include two or three pieces of butter. One hour after completing the meal take the entire contents of one package of Priodax (6 tablets) with a glass of water. During the afternoon eat nothing and drink only water. At 6:00 P.M. eat a fat-free meal consisting of fruit juices, crackers, and sweetened tea or coffee without cream. One hour after supper take the second package of Priodax (6 tablets) with a glass of water. Eat nothing thereafter and drink only a moderate amount of water. Report to the x-ray department the following morning at 8:30.

The divided dose technic substituted 3 tablets following the noon and evening meal instead of 6 as outlined in the double dose. For the single dose all 6 tablets were given following the fat-free evening meal. The other instructions were not changed.

TOXIC EFFECTS

Table I shows the side effects in 163 cases. We want to emphasize that in tabulating these findings every symptom that could be attributed to the Priodax was recorded. One liquid or soft bowel movement was included in the diarrhea column. In many instances symptoms reported as distress or nausea were revealed only after specific questioning. If we considered only pronounced symptoms, the statistics would be quite different, as follows: for the double dose group, nausea in 1 and diarrhea in 10; for the single dose, nausea in 1 and diarrhea in none; for the divided dose group, nausea in none and diarrhea in 1.

TABLE II: GALLBLADDER VISUALIZATION WITH PRIODAX: COMPARISON OF TECHNIQS
(163 Cases)

Method	Cases	Concentration			Number of Cases Showing Calculi
		Good	Poor	None	
Double dose	57	77.4%	12%	10.4%	5
Single dose	51	74.5%	11.8%	13.7%	6
Divided dose	55	83.6%	9.4%	7%	2

The burning sensation was of no great significance. In the throat the patient had a sensation of a slightly caustic substance being swallowed that was of only momentary duration. The bladder symptoms were noted on the first micturition in the morning following the administration of the dye. They occurred, as a rule, immediately after micturition and never lasted longer than five to ten minutes. The burning sensation around the anus was temporary and was never noticed after more than one or two bowel movements following administration of the dye.

Since the analysis of this series of cases, we have used the single dose technic routinely, primarily from an economical standpoint and secondarily to simplify our procedure for the wards. Either may be used, however, with only minor discomfort for the patient.

ROENTGEN FINDINGS

Table II shows the results in 163 consecutive cases with the three technics. The concentration of dye was good in 126 cases. Gallstones were demonstrated in 13 cases in the entire series.

The gallbladder shadow was slightly less dense with the single and divided dose technic than when the double dose was used. Nevertheless, the concentration was satisfactory with either method and, as previously stated, we have adopted the single dose technic as a routine procedure. In 12 questionable cases, in which the single dose was used, the examination was repeated by the double dose technic without obtaining any additional information. We consider the re-examination by the double dose technic unnecessary.

Abnormal gastric acidity has no apparent effect upon the absorption and con-

centration of Priodax. A fractional gastric analysis with histamin was done in 81 per cent of the cases, with the following findings: free hydrochloric acid 0-70, with a total acidity from 0-101. Among these cases 5 per cent showed a definite hyp acidity, and 5 per cent showed a definite hyperacidity. The rest were normal or about normal. Excellent concentration was noted in two cases of achlorhydria.

Gastroscopic examination was done in 2 patients of the double dose group at the time of the roentgen examination. Both showed a normal orange-red gastric mucosa with no evidence of irritation by the Priodax, which was administered the night before. This suggests that the gastro-intestinal irritation is temporary.

Out of the entire series, 94 per cent showed a detectable amount of dye in the colon. In none of these was it sufficient to obscure the gallbladder. Gas in the colon seems to be less frequent than we have previously observed with the use of tetraiodophenolphthalein as a contrast medium for cholecystography.

OPERATIVE FINDINGS

Cholecystectomy was done in 10 cases, in all of which gallstones were present. In 2 of these operated cases no gallbladder shadow was obtained. In one other case with failure to concentrate the dye exploration was done and a relatively normal gallbladder was found. This patient, however, had an icterus index of 44 and clinical jaundice.

A second series of 63 patients has been analyzed for the operative findings. Thirty-nine were normal and 24 presented evidence of gallbladder disease. Twelve of the latter group have been operated on and all had cholecystitis and cholelithiasis.

This gives a total of 22 correctly diagnosed and verified cases of gallbladder disease out of 226 examinations. There are, of course, other cases, as shown in Table I, where gallstones have been demonstrated but the diagnosis not confirmed by cholecystectomy.

SUMMARY AND CONCLUSIONS

1. Priodax was used for cholecystography in 226 patients and appeared to be superior to tetraiodophenolphthalein.
2. The toxic symptoms were analyzed in 163 cases with the double dose, divided dose, and single dose technic. Diarrhea, nausea, and vomiting were infrequent.
3. The gallbladder was never obscured by unabsorbed dye.
4. Cholecystectomy confirmed the roentgen findings in 22 of 226 examinations.
5. A gallbladder found to be apparently normal at laparotomy was not visualized in a patient with clinical jaundice.
6. The single dose technic is most satisfactory.

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CASE REPORTS

Spontaneous Cholecystoduodenal Fistula in a Patient with a Primary Hepatoma of the Liver¹

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G. GRADY, M.C., MAJOR MATTHEW PEELLEN,
M.C., and CAPTAIN MAX MAGNES, M.C.

A case of spontaneous cholecystoduodenal fistula in a patient with a primary hepatoma of the liver is here presented because of several points of interest: (1) the relative rarity of these conditions, and particularly the combination of the two in one patient, (2) the roentgen demonstration and correct interpretation of the findings, as confirmed at autopsy, (3) the racial and geographical significance of primary hepatic cancer.

A 42-year-old corporal, a native of South America, was admitted to Winter General Hospital on Oct. 15, 1943, by transfer from a station hospital. He had entered the station hospital on Sept. 15, 1943, complaining of persistent dull epigastric pain. His appetite was good and there was no vomiting, although he had a sensation of obstruction in the stomach. There was no history of tarry or clay-colored stools. In 1938, the patient experienced an attack of severe epigastric pain which was relieved by a hypodermic injection. No diagnosis was made and he was comfortable up to the time of his admission, except for slight bloating lasting for a few minutes only. The blood findings, as determined at the station hospital, were: red cells, 4,200,000 and hemoglobin 89 per cent. Gastric analysis showed hyperchlorhydria. X-ray examination on Sept. 25 led to a diagnosis of possible diffuse gastric carcinoma or possible syphilis of the stomach. Since admission to the station hospital the patient had lost about twenty-five pounds in weight. He frequently had chills followed by elevation of temperature and profuse perspiration; he stated that he felt cold.

Clinical Findings (Captain Magnes): On examination, on Oct. 16, 1943, at Winter General Hospital, the patient appeared pale and weak. He moved slowly in bed as if he were in pain. On breathing, the lower right chest and upper right abdomen showed splinting; the upper abdomen seemed slightly distended. The lungs and heart were normal. There was rigidity of the upper portion of the right rectus muscle on palpation, and below the xiphoid process on both sides a tender mass was

palpable. This seemed more marked on the right and extended about 4 inches below the xiphoid process. The entire liver was enlarged about 2 inches below the costal margin.

Laboratory Findings (Oct. 18): Red blood cells, 4,300,000; white blood cells, 10,000; hemoglobin, 13.8 gm. Occult blood in the feces, 3+. Total gastric acidity, 49.0; free hydrochloric acid, 45.0; no lactic acid. Van den Bergh test: direct, none; indirect, 0.47 mg. Urine negative.

Roentgen Findings (Major Pomeranz): Radiographic and fluoroscopic study (Oct. 19) showed an orthotonic stomach of fair size, definite hypersecretion, good peristalsis throughout, and no defects. The duodenal cap showed no defects. The liver was enlarged. Fluoroscopic observation, in the prone right oblique position, showed a semicircular, faint linear extension of barium near the superior portion of the duodenum. Spot films disclosed a linear streak of barium entering a negative shadow surrounding this area (Fig. 1). Examination at four hours showed a 5 to 7 per cent barium residue in the fundus of the stomach, at the lesser curvature, evidently resting against the left lobe of the liver; spotted barium residue in the pyloric antrum and at the site of the described negative shadow, outside of the duodenum; the bulk of the barium meal in the lower loops of the ileum and the colon. A *barium enema* revealed no organic lesion of the colon. A *Graham test* was done on Oct. 25. With the divided dose method (6 gm.), no definite shadow of the gallbladder was obtained either before or after the test meal. A recheck study of the stomach and duodenum, after positioning of the patient in the prone right lateral and oblique positions, showed slow penetration of the barium fluid into the gallbladder area, definitely pointing to the presence of a fistula.

The roentgen observations were summarized as follows: Spontaneous cholecystoduodenal fistula between the superior portion of the duodenum and gallbladder, evidently pathological; possible stone in the cystic duct of the gallbladder, obstructive. An underlying malignant lesion of the biliary tract could not be ruled out. The liver was enlarged.

Clinical Course: In view of the above findings, and because of continued chills and fever (up to 104°), the patient was referred to the surgical department for exploration. The surgeon suspected that, in addition to the above findings, there was a right subhepatic abscess, secondary to the biliary fistula.

Operative Findings (Major Peelen): Operation was done Nov. 5, 1943. A four-inch incision was made parallel to the twelfth rib, the periosteum was incised, and the twelfth rib removed up to its neck. The rib bed was then divided transversely and the peritoneum was stripped forward until the

¹ Accepted for publication in April 1944.

liver was reached. Definite nodules, like those of carcinoma, could be palpated on the liver, but no evidence of abscess was found. The wound was closed in routine manner. The patient was then placed on his back, and an upper right rectus incision was made. A small amount of straw-colored fluid in the peritoneal cavity was observed. On exploration, the right lobe of the liver showed multiple small metastatic areas. The left lobe was

jaundice, which continued to increase. On Nov. 27, there was a definite change for the worse, and edema of the right leg developed, extending upward in a few hours to involve the entire thigh. Death occurred on Nov. 28, 1943. There was no fever after the first ten days following operation.

Autopsy Findings (Major Grady): The skin and sclerae were deeply jaundiced. The right lower extremity from the groin to the ankle was edematous,

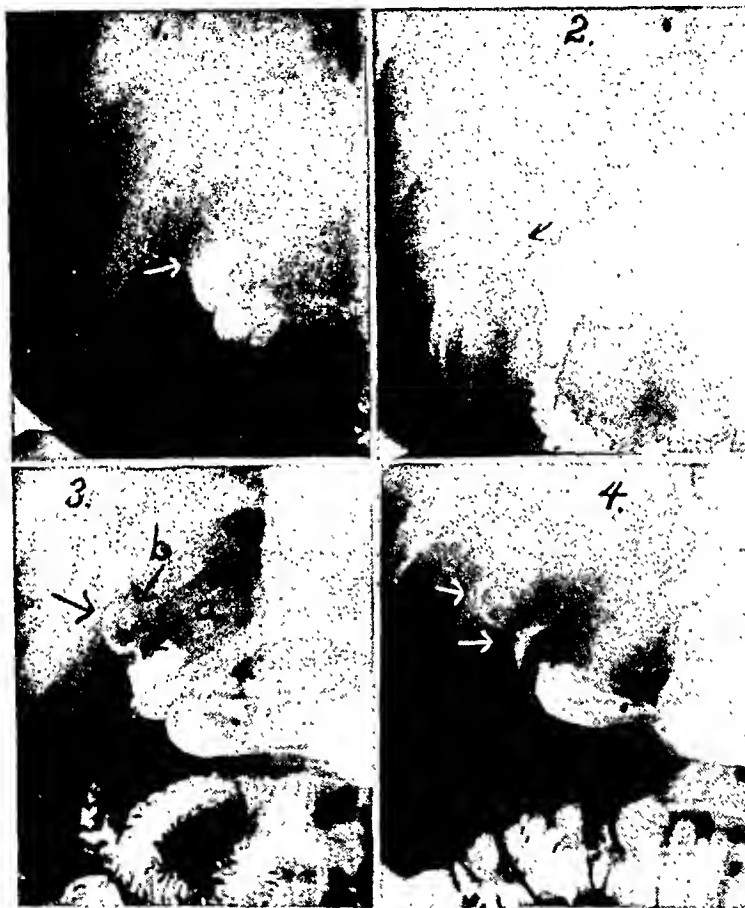


Fig. 1. Four successive views taken at five- to fifteen-minute intervals, showing successive stages of penetration of barium through the fistulous tract around the gallstone. a. Fistulous tract. b. Stone in gallbladder.

firm and hard throughout. The gallbladder was fixed in a firm mass. The stomach and duodenum, as well as the remainder of the abdomen, appeared normal, except for several enlarged pre-aortic nodes and fixation of the gastrohepatic ligament. One of the liver nodules was removed for biopsy, and the liver wound was reapproximated. The biopsy report was secondary adenocarcinoma of the liver. The primary site of the tumor could not be determined histologically.

Postoperative Course: The wounds healed by primary intention, but the patient grew weaker day by day. On Nov. 15, he began to show evidence of

being at least one-half as large again as the left extremity. Internal examination revealed 200 c.c. of blood-tinged amber fluid in the peritoneal cavity. Both lobes of the liver were adherent to the diaphragm, and the lesser curvature of the stomach was adherent to the inferior surface of the left lobe of the liver. The omentum was adherent to the parietal peritoneum in the right upper quadrant at the site of the recent surgical incision.

The heart weighed 210 gm. The myocardium was flabby and red-brown. The aorta, which was of normal width, showed in its abdominal segment lightly streaked and flecked orange-yellow athero-

was no gross evidence of tumor. The cystic duct appeared normal. The common duct contained a friable black calculus, the size of a split pea, lying loosely at the ampulla of Vater. The mucosa was light yellow and free of tumor. The nodes at the neck of the gallbladder and about the common duct were enlarged up to 0.8×2.8 cm. and were firm, dry, and pale yellow. A similar retroperitoneal para-aortic node at the level of the first lumbar vertebra was noted.

The adrenals were of normal size and shape. In

seat of severe inflammatory reaction. There were many engorged capillaries and a heavy infiltration of plasma cells with smaller numbers of lymphocytes and fibroblasts.

The para-aortic and cystic lymph nodes were almost wholly replaced by tumor. The tumor cells were growing in cords, sheets, and in some areas as acini. There was extensive necrosis.

There was secondary adenocarcinoma of both adrenals.

Diagnosis: Myocardial degeneration. Right ex-

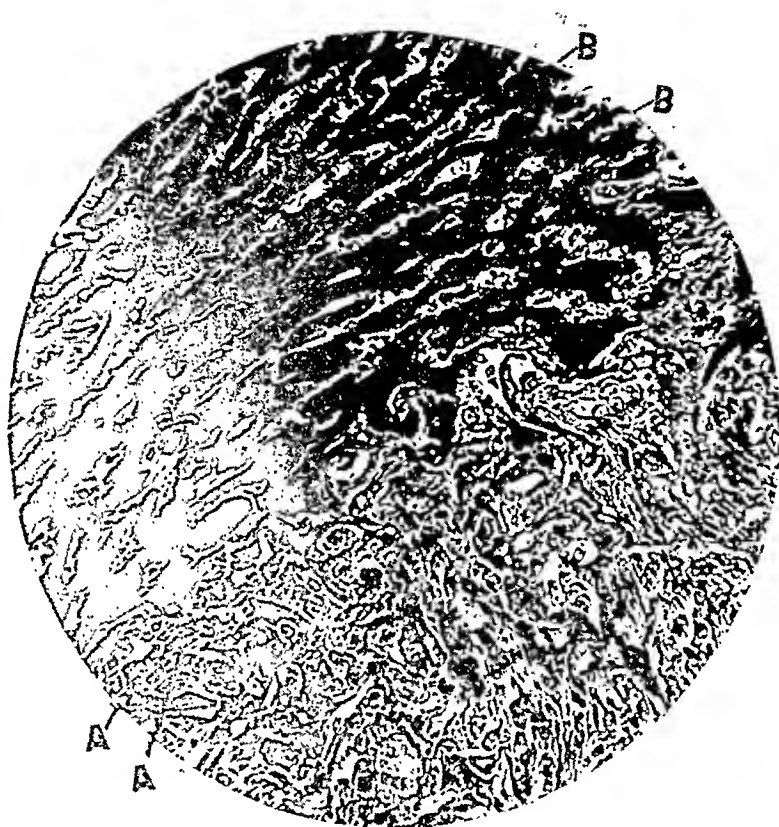


Fig. 5. Microscopic section of liver ($\times 300$). Connective-tissue stain. A. Tumor cells. B. Intervening liver cells.

the medulla of each were two sharply defined, pale gray metastatic nodules, 1 to 2 mm. in diameter

Microscopic Examination (Figs. 4 and 5): Sections of the liver showed extensive replacement by tumor, which varied in morphology. In some areas it was composed of cords of large polygonal cells with large nuclei and prominent nucleoli, with a finely granular or vacuolated cytoplasm. In such areas there was a definite resemblance to liver cell cords. In other areas, the tumor formed clear-cut acini lined by cuboidal or columnar tumor cells. No "brush border" could be recognized. There was a considerable degree of necrosis. Mitotic figures were numerous. Growth was highly invasive. Sections showed the gallbladder adherent to the liver and free of tumor. The mucosa was extensively ulcerated and was the

ternal iliac venous thrombosis. Hemorrhagic infarction, right lower lobe. Pulmonary arterial thrombosis and embolism, postoperative. Primary adenocarcinoma of the liver. Chronic calculous cholecystitis. Cholecystoduodenal fistula, spontaneous. Portal venous thrombosis. Secondary adenocarcinoma of both adrenals and of the cystic and para-aortic nodes.

COMMENT

(Major Pomeranz)

According to statistics quoted by Feldman, the incidence of spontaneous biliary fistulae is 0.4 per cent; 43 cases were found

in a series of 10,866 autopsies reported by Roth, Schroeder, and Schloth. The first example of spontaneous biliary fistula recognized by x-ray was reported by Hunt and Herbst in 1915 and was shortly followed by another case presented by Carman and Miller. Garland and Brown reviewing the literature up to 1942, found 90 cases of spontaneous internal biliary fistulae recognized by x-ray and later verified. They include in this number 5 cases of their own (out of 7) which were correctly diagnosed by x-ray and later verified by surgery or autopsy. Ninety cases do not appear many in view of the vast number of gastro-intestinal x-ray studies performed. The most common cause of these fistulae is chronic gallbladder disease with the formation of stones which perforate into the gastro-intestinal tract. This was the cause in our patient. The first inkling of the presence of the lesion in this case was obtained on fluoroscopic observation of the linear penetration of the barium outside the limits of the duodenal outline, in a semicircular fashion around a negative shadow, later interpreted as a stone.

Primary carcinoma of the liver is another lesion with a very low incidence. Ewing quotes reports by Orth and Hensemann, placing the incidence at 0.5 per cent of all cancers. Goldzieher and Bokay reported, among 6,000 cases, an incidence of 1.3 per cent in five years. A higher incidence of primary liver cancer has been reported in the Philippine Islands (1.4 per cent), in Africa, South America, and China, where the figure has risen to 6.9 per cent. The average incidence, based on all reports, is about 0.2 per cent (Lichtman). In our case, the cancer of the liver was suspected clinically only. I should like to call attention, however, to a roentgen symptom seen in this case on the four-hour film. This showed a "selective" barium residue at the lesser curvature of the gastric fundus, near the left lobe of the liver. The autopsy revealed that the lesser curvature of the stomach was adherent to the posterior under-surface of the left lobe of the liver; there was a line

of cleavage, and the gastric wall was separated cleanly. In my opinion, the impaired gastric motility with the "selective" residue was caused by the adhesion probably formed as a result of the rapid liver growth, approximation of the liver with the stomach, and the reactive peritoneal changes. This roentgen finding, which was ignored, could well have served as a diagnostic point indicating adhesions in this area, particularly in association with a rapidly growing and enlarged liver.

The case recorded combines two unusually rare pathological lesions. As far as we can determine, no report of a combination of these two lesions in one patient appears in literature. It is evident that the spontaneous biliary fistula preceded the neoplasm. How much the chronic infection of the biliary tract contributed to the development of the primary hepatic carcinoma, is a matter of speculation. It is probable that these two conditions developed independently. The case is also unusual in that microscopic study of the liver revealed no evidence of cirrhosis. This is associated with hepatomas in 85 per cent of the cases. Hereditary, geographical, and dietary factors may be taken into consideration, in view of the greater incidence of primary liver cancer in the southern hemisphere.

Note: Grateful acknowledgment is made of the co-operation of members of the professional staff of Winter General Hospital.

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An Unusual Gastrocolic Communication¹

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A white male aged 48 years, previously well, experienced an attack of vomiting following a heavy meal, accompanied by severe pain, slight abdominal distention, and a feeling of stiffness in the abdomen. He described the vomited material as of a brownish color and a foul odor. In view of the subsequent observations in the hospital it would appear to have been fecal in character. He did not seek medical advice, however, until about two weeks later, having had several less severe attacks in the interval.

The patient appeared underweight and undernourished but had no immediate complaints. He gave no history of gastrointestinal disease or of any abdominal complaints; he had never been operated upon, had always had a good appetite, and, so far as he knew, had never vomited blood or experienced rectal bleeding. In spite of his apparent emaciation, he stated that he had lost no weight up to the initial attack of vomiting two weeks earlier and only a little since that time. There was no palpable mass, and no tenderness could be elicited over any part of the abdomen. The left upper quadrant, however, was firm to pressure.

Examination of the digestive tract following a barium meal showed a most unusual communicating tract between the stomach and colon, approximately 11 cm. in length, lying in the left half of the abdomen. The upper part of this tract, which was filled with barium, was triangular in form, measuring approximately 7 cm. across and 4 cm. in depth. The remainder of the tract, which continued to join the transverse colon in the region of



Fig. 1. Roentgenogram showing (A) triangular segment of stomach, (B) the narrow tract between it and the remainder of the stomach, (C) the surrounding ring of carcinomatous tissue, (D) continuation of the gastrocolic fistula, and (E) the point of communication with the transverse colon.

the splenic flexure, had a maximum width of about 3.5 cm. In its middle lateral third was a small hook-like projection of barium. In the stomach itself there was a clearly demonstrable filling defect in the nature of a slightly ragged indentation along the greater curvature, involving also the cardiac and pyloric regions. Only a narrow channel remained through which barium passed into the triangular portion of the tract leading to the colon.

The possibility that the triangular collection of barium represented a part of the stomach, separated from the remainder of the organ by a segmenting type of carcinoma was immediately suggested. The question as to the nature of the distal portion of the communicating tract was puzzling. It was believed that it might be a fistulous tract, though its outline was more sharply defined than would be expected. If it were, indeed, a fistula, the problem of its origin remained. Was it due to canali-

¹ Accepted for publication in March 1944. Published with permission of the Medical Director, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the author.

zation through neoplastic tissue? Or was it a pathway through a mass of adhesions subsequent to an abdominal abscess or peritonitis? As stated above, there was no palpable mass such as would be expected in the presence of a large carcinoma, though there was a firmness to pressure over the abdomen. No part of the communicating tract showed a mucosal pattern identical



Fig. 2. The six-hour roentgenogram showing gastric retention.

with that of the stomach, small bowel, or colon. On the other hand, there was a decided similarity in the appearance of the almost completely emptied stomach and the almost completely emptied tract.

From the gastrocolic tract the barium passed to the right, through the transverse colon and hepatic flexure, into the ascending colon and cecum. None was observed to pass to the left, and there was no demonstration of the descending colon, iliac colon, sigmoid, or rectum, up to and including the ninety-six-hour roentgenogram.

The findings at successive examinations following the barium meal may be briefly



Fig. 3. Barium enema study, showing the rectum, sigmoid, and descending colon, structures which were not revealed by the barium meal. There is still slight retention of the barium meal in the stomach, gastrocolic fistula, and transverse colon. The barium administered by enema did not reach into the stomach or extend through the transverse colon.

summarized. The *six-hour film* showed gastric retention and filling of the fistulous (?) tract and the right two-thirds of the transverse colon, the ascending colon, and cecum. There was also a considerable amount of barium within the loops of the ileum low in the median third of the pelvis. The picture was thus one of gastric retention, with two exits from the stomach—one through the communicating tract and the other through the pyloric canal and duodenum.

The *twenty-four-hour film* showed moderate retention in the stomach, duodenum, the communicating tract, terminal ileum, right half of the transverse colon, and ascending colon and cecum, with the merest suggestion of a descending colon.

At *forty-eight hours* a small amount of barium was adherent to the mucosa of the stomach and of the gastrocolic tract. The character of the deposition of the barium

in the tract was identical with that in the adjacent portion of the stomach, lending further support to the impression that at least the upper portion of the tract was actually part of the stomach cut off as the result of a carcinoma or possibly a benign neoplasm.

At *ninety-six hours* there was a trace of barium in the gastrocolic tract and in the transverse and ascending colon, cecum, and appendix.

Immediately following the ninety-six-hour examination a barium enema was given. The barium passed readily through the rectum, sigmoid, and descending colon up to a point corresponding to the junction of the gastrocolic tract with the transverse colon. During a fifteen-minute fluoroscopic observation not enough barium passed this point to be demonstrable. Nor did roentgenograms made immediately after the fluoroscopic examination or one hour later show more than a trace of barium in the transverse colon beyond the obstruction. Thus, while barium passed readily from the stomach through the communicating tract, none could be made to pass in the opposite direction, up through the tract into the stomach, indicating a valve-like action in the region of the junction between the gastrocolic tract and the colon. The upper border of the barium within the loop of the splenic flexure adjacent to the lower end of the gastrocolic communication was somewhat ragged in character. The descending colon, sigmoid, and rectum showed no filling defects.

In view of the observations described above, several possibilities entered into consideration: (1) gastric carcinoma with ulceration; (2) a slowly perforating or seeping non-malignant peptic ulcer with fibroid tissue reaction and fistula formation; (3) a left intra-abdominal abscess, perirenal or otherwise, with subsequent

fibroid tissue reaction and development of a fistula; (4) an anomaly, which appeared rather unlikely.

At operation the stomach was found to be the seat of a neoplasm 10 to 12 cm. in diameter, involving the greater curvature, the gastrocolic omentum, and the mid-portion of the transverse colon. Within this large, firm, nodular growth was the gastrocolic fistula previously demonstrated roentgenologically. The part of the stomach corresponding to the ragged indentation at the greater curvature seen roentgenologically showed a broad ring-like band of carcinomatous tissue running parallel to the curvature. It was this band that accounted for the appearance of segmentation in the roentgenogram. Within it lay that section of the communicating tract connecting the large upper part of the stomach with the lower and smaller triangular portion, which in the roentgenogram appeared to constitute the upper part of the unusual gastrocolic fistula. The patient died on the day of operation, one month following the first appearance of symptoms.

Microscopic study of a section of the stomach showed a transition of mucosa into atypical areas that invaded all layers, with mitotic figures. The tumor tissue was found to be markedly glandular in type at a distance from the site of origin of the tumor. The diagnosis was adenocarcinoma grade 4.

It is interesting to speculate as to how long this carcinoma with its unusual fistulous tract had been in the process of growth before the establishment of communication with the colon. In the absence of any symptoms referable to the digestive system up to two weeks before examination, this question must remain unanswered.

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EDITORIAL

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The Roentgen Examination in Surgical Conditions of the Lungs

The Gargantuan strides of the thoracic surgeon, taken largely during the past decade, present a real challenge to the roentgenologist. The feasibility of surgery, not only for symptomatic relief or palliation but for the cure of a host of pulmonary diseases, especially tuberculosis, pulmonary abscess, actinomycosis, bronchiectasis, lung cysts, and tumors, has now been thoroughly tested and largely accepted. The recent observation of the successful extirpation of an entire lung from an infant of six months for the cure of an expanding lung cyst, which had reduced the vital capacity to a point almost incompatible with life, gives adequate evidence of the accomplishments of thoracic surgery. The statistical studies of the operative mortality from lobectomy and pneumonectomy are possibly even better witnesses. The problems of anesthesia particularly, but also of blood loss and the control of intrapleural and intrapulmonary pressures, have been largely overcome, while the surgical technic has been perfected to an astonishing degree.

There remain the problems of early diagnosis so that the surgeon may be afforded some opportunity of success, of differential diagnosis so that a radical operation is not attempted for improper indications, and of the delimitation of the pathological process so that the surgery is restricted to the minimum amount compatible with a complete cure.

The answer to these problems lies largely in the field of thoracic roentgenology. It is true that the freedom with which bronchoscopy is now used and the increased ability of the pathologist to inter-

pret bronchial biopsies have added immeasurably to pulmonary diagnosis, especially in lung tumors. Newer methods of sputum examination, differential bronchospirometry, careful assessment of vital capacity, and pressure determinations by means of paracentesis of the pleura, or of cavities within the lung, whether tuberculous or non-tuberculous, have added much to the armamentarium of the student of pulmonary pathology. Nevertheless, the major contributions to the problems of thoracic diagnosis are the responsibility of the roentgenologist.

Fortunately roentgenologic technics, at least to some degree, have kept abreast of the advances in thoracic surgery. It is a far cry from the customary routine stereoscopic postero-anterior films of the chest made in the upright position in deep inspiration to the present complex procedures which are usually necessary in studying the chronic diseases of the lungs for the cure of which radical surgery must be used. In such cases, the roentgen examination should consist of a number of steps, systematically approached. Ideally, the first procedure should be the fluoroscopic examination, which may well serve as a scouting expedition. While there is no doubt that small lesions may not be discovered in this way, it is usually a gross lesion which requires surgical attention. The opportunity to study the lungs in full inspiration and full expiration, with the patient rotated into every possible obliquity, or from lordosis to kyphosis, in order that the abnormal areas may be struck tangentially by the roentgen rays, is virtually impossible to obtain in any other manner.

From such a study information is obtained which indicates the nature and location of the abnormality and prescribes the positions in which roentgenograms are to be made. Too much emphasis cannot be placed upon the selection of the exact position which will best demonstrate the lesion. A slight obliquity may enable the clear visualization of a calcified plaque or the edge of a shallow cyst which might otherwise completely escape detection; the position of lordosis may demonstrate an atelectatic right middle lobe not otherwise clearly seen. Likewise, a change in position from upright to supine, from prone to lateral decubitus, may determine unequivocally the presence of fluid within the pleural cavity or within an intrapulmonary cavity. Aside from cases in which the presence of a foreign body in the bronchus is suspected, roentgenograms in the expiratory phase of respiration are too often not obtained, although these may be crucial in the early diagnosis of intrabronchial tumors. In addition, the use of a grid may help to clarify conditions within a dense lung.

At this point, it may be possible to predict accurately the nature of the lesion and its extent; enough may have been accomplished to make further studies unnecessary. More commonly, particularly in the case of lesions obstructing the bronchi or involving them extensively, further examinations must be undertaken. Body-section roentgenography, whether it be by planigraphy or laminagraphy, should be the next step. By this means the presence of an obstructing mass in the bronchus, its nature and location, may be ascertained. The presence of cavities in the lung, the determination of their extent, and the detection of an accompanying tumor may thus be elucidated. Furthermore, masses, calcified or otherwise, about the bronchi, at the bifurcations, and in the mediastinum are often localized in sectional roentgenograms.

If the information as to the nature and extent of the lesion is still not sufficiently

exact, bronchography with iodized oil should be undertaken. The presence of an obstructing lesion of the bronchus, some information as to whether it is neoplastic or inflammatory, its exact location and extent may be verified. Particularly in the case of bronchiectasis or cystic disease of the lungs, the distribution and extent of the lesions may best be mapped out by bronchography. It is important to make certain that the process is confined to one lobe or another, or to a part of one lobe and a part of another, in order that the surgeon may succeed in extirpating all of the abnormal areas or, contrariwise, to demonstrate that surgery is not feasible at all.

Finally, during the course of lung surgery on the operating table, and for some days thereafter, repeated roentgenograms of the chest may be necessary to determine accurately the degree of pneumothorax or hydrothorax and the amount of mediastinal displacement or compression of the contralateral lung, in order that remedial measures may be promptly undertaken to counteract the serious effects of excessive displacement of the mediastinum.

The addition of the findings obtained by these various roentgen procedures to the information available from the history, physical examination, and from the special procedures enumerated above, may permit very accurate conclusions as to the nature and extent of a surgical lesion of the lung in the majority of instances.

There remain, nevertheless, many unsolved problems. Further efforts in the direction of more accurate differentiation of the neoplastic or inflammatory nature of a peripheral nodule or of a cavity in the lung, of a tuberculous from a non-tuberculous lesion, of an infected cyst or a pulmonary abscess from an encapsulated pocket in the pleura, are still imperative. By and large, however, the improvement in roentgen diagnosis has followed closely upon the improvement in thoracic surgery. Both have resulted in a considerable reduction in the mortality from pulmonary disease.

LEO G. RIGLER, M.D.

ANNOUNCEMENTS AND BOOK REVIEWS

THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

The Radiological Society of North America announces the following officers for 1944-45: President, Lewis G. Allen, M.D., Kansas City, Kans.; President-Elect, Lowell S. Goin, M.D., Los Angeles, Calif.; First Vice-President, Sydney J. Hawley, M.D., Danville, Penna.; Second Vice-President, Robert R. Newell, M.D., San Francisco, Calif.; Third Vice-President, John S. Bouslog, M.D., Denver, Col.; Secretary-Treasurer, Donald S. Childs, M.D., Syracuse, N. Y.; Librarian, Howard P. Doub, M.D., Detroit, Mich.

Members of the Board of Directors are Frederick W. O'Brien, M.D., Boston, Mass., *Chairman*; James J. Clark, M.D., Atlanta, Ga.; Edgar P. McNamee, M.D., Cleveland, Ohio (to fill the unexpired term of Dr. Davis Spangler, resigned); Warren W. Furey, M.D., Chicago, Ill.; Lewis G. Allen, M.D., Kansas City, Kans.; Lowell S. Goin, M.D., Los Angeles, Calif.

AMERICAN ROENTGEN RAY SOCIETY

At the recent meeting of the American Roentgen Ray Society the following officers were elected: President-Elect, Dr. Ross Golden, New York City; First Vice-President, Dr. Raymond C. Beeler, Indianapolis; Second Vice-President, Comdr. Harold Jaeox, M.C., USNR, Great Lakes, Ill.; Treasurer, J. Bennett Edwards, Leonia, N. J.; Secretary, H. Dabney Kerr, Iowa City, Iowa.

At this meeting Dr. Lyell S. Kinney of San Diego, Calif., assumed the Presidency.

A LETTER FROM OVERSEAS

The following paragraphs are from a letter recently received from a member of the Radiological Society of North America now in overseas service.

"I sometimes wonder how much the people back home realize what is being fought for over here, and an incident occurred the other day, associated with my radiological career, which I thought I would pass back to my associates in the RSNA in case any of them wonder, as I often have, what this business is all about.

"Many people back home will, of course, remember Dr. Solomon from L'Hôpital St. Antoine in Paris, who was one of the leading exponents of x-ray standardization in France and who represented that country at our last International Conference in Chicago. He was a dear friend of mine and I worked with him in Paris for a considerable period in 1931, during which time I grew to know his family quite well. He, of course, died in 1938 or thereabouts,

but upon passing through Paris recently, I tried to look up the family and inquire as to their well being.

"Upon finding their home empty, I inquired of a next-door neighbor as to their whereabouts and from this person learned the following story: A few weeks after the entrance of the Germans into Paris, in 1941, a squad of German soldiers appeared at the Solomon home, seized the son (35 years old and a promising physicist), took him out into the court behind the house, shot him and left him there. A few months later, the daughter, age about 30, was similarly taken from home, along with a considerable number of other French women, and shot as a hostage for some act of sabotage which had been committed in Paris. At about the same time, the mother was seized and sent to a disposal camp (one of those spots when once entered, no one ever leaves alive). The home was taken over temporarily by some German officers, and later all of the contents were divided up among German officers and taken away.

"Of course, the Solomon family had committed a very grievous offense—they were Jews."

ELEVENTH ANNUAL POSTGRADUATE DAY UNIVERSITY OF TOLEDO

On Nov. 3, 1944, the Medical Institute of the University of Toledo observed its Eleventh Annual Postgraduate Day, with a program dedicated to the memory of Dr. John Thomas Murphy, an alumnus of the old Toledo Medical College and a Trustee of the University at the time of his death.

As was fitting, the program was devoted to roentgenology. The speakers were Lt. Col. Joseph C. Bell, Percy Jones Hospital, Battle Creek, Mich., Col. B. R. Kirklin, of the Mayo Clinic, now serving as Chief Consulting Roentgenologist, Office of the Surgeon-General, A.U.S., and Dr. U. V. Portmann of the Cleveland Clinic.

A "Memoriam to Doctor Murphy" was delivered by Dr. F. M. Douglass of Toledo at the opening of the evening session.

DR. GEORGE A. UNFUG HONORED

RADIOLOGY records with pleasure the choice of a member of the Radiological Society of North America, Dr. George A. Unfug, of Pueblo, Colo., as the new President-Elect of the Colorado State Medical Society. Doctor Unfug is also a member of the American College of Radiology and a diplomate of The American Board of Radiology. Of him the *Rocky Mountain Medical Journal* says: "He will be one of the youngest members ever to be elected President, and is held in high regard professionally and personally by all who know him."

DIRECTORY OF MEDICAL SPECIALISTS

Certain changes in the *Directory of Medical Specialists* have been announced for the Third Edition, to appear in 1945. They are published here to assist diplomates of the American Board of Radiology who may be preparing their history for this new edition.

"The biographic data of the first two editions of the Directory of Medical Specialists included only position (internships, residencies, or assistantships) held during the course of training of men up to the time of their certification by the American Boards, and hospital and medical school staff positions then currently held.

"It is desired to extend these data in the Third Edition to include all formal hospital and medical school appointments, with dates held, even though now resigned, as well as records of all military service including commissions and dates, either in World War I, peace-time in the Reserve forces, or in the present war.

"Thus, a chronologically complete sketch of a diplomate's career is to be included in this Third Edition of the Directory.

"Membership or fellowship in national or sectional (not local) special societies, and national general societies with offices held, and dates, in any of these should be reported.

"Membership in recognized international medical societies may be included, but honorary or other membership in foreign medical societies should not be reported.

"Reference to the Second Edition (1942) of the Directory may be made for lists of medical societies to be included in one's biographic sketch.

"Families or secretaries of men absent in military service are asked to complete or correct previous listings or new forms being mailed to those eligible for inclusion in the Directory. Only those certified by an official American Board can be included, and there is no charge for this listing."

Communications should be addressed to The Directory of Medical Specialists, 919 North Michigan Ave., Chicago.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE 1944 YEAR BOOK OF RADIOLOGY. *Diagnosis*, edited by CHARLES A. WATERS, M.D., Associate in Roentgenology, Johns Hopkins University;

Assistant Visiting Roentgenologist, Johns Hopkins Hospital; Associate Editor, WHITMER B. FIROR, M.D., Assistant in Roentgenology, Johns Hopkins University; Assistant in Roentgenology, Johns Hopkins Hospital (on leave with the Armed Forces). *Therapeutics*, edited by IRA I. KAPLAN, B.Sc., M.D., Director, Radiation Therapy Department, Bellevue Hospital, New York City; Clinical Professor of Surgery, New York University Medical College. A volume of 448 pages, with 363 illustrations. Published by The Year Book Publishers, Chicago, Ill. Price \$5.00.

PUBLICACIONES DEL CENTRO DE INVESTIGACIONES FISIOLÓGICAS. Director: PROF. ROQUE A. IZZO. Volumen VII. Pabellon "Las Provincias." Hospital Tornu. Buenos Aires, 1943.

Book Reviews

THE GASTRO-INTESTINAL TRACT. A HANDBOOK OF ROENTGEN DIAGNOSIS. By FRED JENNER HODGES, B.S., M.D., Professor of Roentgenology, University of Michigan Medical School, Ann Arbor, Michigan. A volume of 320 pages, with numerous illustrations. Published by The Year Book Publishers, Inc., 304 S. Dearborn St., Chicago, Ill. Price \$5.50.

This volume is the second in a series of handbooks of roentgen diagnosis which are being published by the Year Book Publishers. It follows the general plan of the preceding volume, the descriptive material being condensed but amply illustrated with excellent cuts.

The book is divided into six sections: The Esophagus, The Upper Gastro-Intestinal Tract, The Biliary Tract, The Colon, The Abdomen Generally, and Findings of Particular Interest. At the beginning of each section are listed the conditions to be discussed in that section. The descriptions, though brief, are adequate for a handbook of this type. Some clinical information is included, together with clues to differential diagnosis. The author draws on his wide experience to include helpful hints for those less familiar with the subject. The cuts alone are invaluable, as an atlas.

The volume comprises 320 pages with 604 figures, of which 121 are full-page plates. A short bibliography is given at the end of each section, and an adequate index is appended.

This Handbook is highly recommended to students and roentgenologists, as well as to gastroenterologists and surgeons, as presenting an excellent summary of an important subject.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse 2, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago 11, Ill.

Section on Radiology, American Medical Association.—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Earl R. Miller, M.D., University of California Hospital, San Francisco, Calif.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Meets annually during meeting of California Medical Association.

San Diego Roentgen Society.—Secretary, Henry L. Jaffe, M.D., Naval Hospital, Balboa Park, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Martha Mottram, M.D., Suite 1789, 450 Sutter St., San Francisco. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital, from January to June; at Lane Hall, Stanford University Hospital, July to December.

COLORADO

Denver Radiological Club.—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, Charles M. Gray, 306 Citizens Bldg., Tampa 2.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St., Baltimore 1. Meets third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, E. W. Spinzig, M.D., 2646 Potomac St. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha 2. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—Secretary-Treasurer, George Levene, M.D., Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. R. Brindle, M.D., 501 Grand Ave., Asbury Park. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave., Brooklyn 26. Meets fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month. October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Ramsay Spillman, M.D., 115 E. 61st St., New York 21, N. Y.

Rochester Roentgen-ray Society.—Secretary, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 p.m. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—Secretary-Treasurer, Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia 4. Meetings held first Thursday of each month at 8:15 p.m., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Lester M. J. Freedman, M.D., 4800 Friendship Ave., Pittsburgh 24, Pa. Meetings are held on the second Wednesday of each month at 4:30 p.m., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—Secretary, A. M. Popma, M.D., 220 North First St. Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison 6, Wis. Meets every Thursday from 4 to 5 p.m., Room 301, Service Memorial Institute.

CANADA

La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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THE HEAD AND NECK

The Morgagni-Stewart-Morel Syndrome. Report of a Case with Pneumoencephalographic Findings. Matthew T. Moore. *Arch. Int. Med.* 73: 7-12, January 1944.

The triad of hyperostosis frontalis interna, obesity, and virilism was described originally by Morgagni in 1765. Stewart, in 1928, added the clinical feature of a psychosis to the syndrome, and Morel, in 1930, gave the first account of the condition in a living person, bringing the group picture of calvarial hyperostosis and endocrine, metabolic, and neuropsychiatric manifestations into clearer relief as an entity. Sherwood Moore's study of numerous roentgenograms of the skull (*Am. J. Roentgenol.* 35: 30, 1936) revealed that among 6,650 specimens four types of calvarial hyperostosis could be distinguished: hyperostosis frontalis interna, nebula frontalis, hyperostosis calvariae diffusa, and hyperostosis frontoparietalis, in the order of frequency named. He defined a symptom complex which later he termed "metabolic craniopathy." The entire syndrome has eventually been broadened to include the original concept of Morgagni, that of Stewart and Morel, and the signs and symptoms described by subsequent authors.

In the main, the syndrome consists of the following elements: one of the types of calvarial hyperostosis described by Moore; endocrine and metabolic disturbances, such as obesity, virilism, and menstrual disorders in female patients and gonadal deficiency in male patients; hypertension, and neuropsychiatric manifestations, such as headaches, cranial nerve defects (disturbance in olfaction, seventh nerve palsy, diplopia, amblyopia), fatigability, muscular weakness, narcolepsy, convulsive seizures, inco-ordination, dizziness, staggering gait, attacks of sweating, disturbances of speech, mental dullness, defects of memory, changes in personality, irritability, mental deterioration and, terminally, dementia. It is not essential, however, that all of these manifestations, with the exception of the pathognomonic roentgen finding of hyperostosis interna, be found in an individual case.

The syndrome may readily be confused with other endocrine or neuropsychiatric disorders, especially psychoneuroses, dementia paralytica, multiple sclerosis, and brain tumor. The author reports a case which was for many years dismissed as a harmless psychoneurosis, illustrating the failure to recognize the condition over a long period because of its slowly progressive and apparently innocuous nature. The patient was a 39-year-old woman presenting the syndrome of calvarial hyperostosis with metabolic, endocrine, and neuropsychiatric disturbances. Pneumoencephalograms (reproduced in the paper) showed evidence of cerebral degeneration in the form of frontoparietal cortical atrophy, atrophy of the islands of Reil, asymmetry of the lateral ventricles, and moderate internal hydrocephalus.

In view of the fact that the Morgagni-Stewart-Morel syndrome often occurs in incomplete patterns, the author suggests that the cerebral changes occur at a slow and irregular rate, *pari passu* with the metabolic craniopathy, and reflect a reaction of the individual tissues to an altered metabolic state. When the craniopathy and endocrine manifestations predominate and no

overt psychoneurosis or psychosis exists, then the Morgagni appellation is given; if, in addition, neuropsychiatric disorders appear, the Stewart-Morel designation is attached.

Cervical Syringomyelia and Syringomyelia-Like States Associated with Arnold-Chiari Deformity and Platybasia. Ben W. Lichtenstein. *Arch. Neurol. & Psychiat.* 49: 881-894, June 1943.

Although roentgenological procedures are not mentioned in this article, the subject matter is of interest to roentgenologists who employ aerographic methods in studying central nervous system lesions. The organic derangements of the brain and cord which may be found in association with developmental defects of the skull base and the upper cervical vertebrae are described and discussed.

Displacement of the structures of the hind brain into the upper portion of the spinal canal occurs frequently in platybasia. The fourth ventricle has been discovered as low as the fifth cervical vertebral segment. Vascular inadequacies resulting from traction or compression of vessels sometimes result in profound necrotic changes in nervous tissue and changes in cerebrospinal fluid dynamics may co-operate to produce a situation resembling syringomyelia.

It is well for roentgenologists to bear in mind the likelihood of associated or at least coexistent neurological disease when the film signs of platybasia are observed.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (F. J. H.)

Agensis of the Corpus Callosum with Possible Porencephaly: Review of Literature and Report of a Case. A. T. Bunts and J. S. Chaffee. *Arch. Neurol. & Psychiat.* 51: 35-53, January 1944.

Agensis of the corpus callosum is a rare anomalous condition of the brain which may be demonstrated encephalographically. Bunts and Chaffee review the 14 cases in the English literature in which an antemortem diagnosis of this anomaly has been made and add an interesting case of their own associated with a possible porencephalic cyst.

The salient encephalographic signs encountered in agensis of the corpus callosum are best seen in sagittal projections. They consist of pronounced separation of somewhat dilated lateral ventricles, elevation and dilatation of the third ventricle, and elongation of dilated interventricular foramina. A so-called "bat-wing" configuration of the ventricular system may be produced. In lateral views, a peculiar "cocked-hat" appearance of the third ventricle and disproportionate dilatation of the posterior horns of the lateral ventricles may be seen.

The very important differential diagnosis between agensis of the corpus callosum and cyst of the cavum septi pellucidi is discussed in detail. The outstanding differential point is that in cyst of the cavum septi pellucidi (fifth ventricle) the third ventricle is not significantly elevated.

An electroencephalogram was done in the case presented by the authors and, although the pattern was definitely abnormal, it could not be considered diagnostic.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (J. H.)

THE CHEST

Pulmonary Tuberculosis in Wellington: A Radiological Investigation Among Office and Factory Workers and Secondary School Children. Marie Stringer Buchler. *New Zealand M. J.* 43: 73-81, April 1944.

The results of a survey of 2,204 males and females from factories, offices, and secondary schools are reported. The ages ranged from fourteen to over sixty years. The survey was carried out under the auspices of the New Zealand Department of Health. It was originally intended to use the Mantoux test as a screen and to examine positive reactors with 14 X 17-inch film. It was later decided to abandon the Mantoux test and use miniature films, since this was found to be less expensive, less time-consuming, and a more popular procedure.

Transport to the hospital where the examinations were made was provided to help insure participation and facilitate rapid examination. All examinations were made on 35-mm. film with a Contax III camera with F 1.5 lens, and Patterson fluoroscopic screen. Factors used for an average chest (20 cm.) were as follows: tube-screen distance 36 inches; 76 kv. p.; 120 ma.; 3/10 seconds.

All persons showing pathological changes were notified to report for further examination, with 14 X 17-inch films.

The results are tabulated according to sex, age groups, and occupation. Also the incidence of tuberculosis found in workers in various types of industry is tabulated, but the groups are generally too small to have statistical significance.

A total of 95 persons were referred for examination with 14 X 17-inch film, and 87 were requested to report to the chest clinic for special examination. The incidence of tuberculosis among all females in industry was 2.6 per cent, among clerical and school workers 2.8 per cent, among males in industry 4.9 per cent, and among male clerical workers 2.0 per cent. The incidence of active pulmonary tuberculosis was 0.6 per cent.

H. H. WRIGHT, M.D.

Diagnosis of Bronchiectasis in Young Adults. Prebronchographic Roentgen Manifestations Observed Among Military Personnel. William A. Evans, Jr. and Leon J. Galinsky. *Am. J. Roentgenol.* 51: 537-547, May 1944.

Bronchiectasis has been the most common chronic pulmonary condition at the station hospital from which this report comes. The soldier's history as revealed by response to questioning proved in general to be unreliable and the roentgen data therefore assumed an especially prominent role in raising the suspicion of bronchiectasis.

The material upon which the report is based consisted of 95 cases in which bronchograms had been made and prebronchographic roentgenograms were available for examination. In this series a slowly resolving bronchopneumonia was observed in 28 of the 37 cases with frank bronchiectasis, in 14 of the 24 with minimal or questionable bronchiectasis, and in 11 of the 34 in which no bronchographic evidence of bronchiectasis was obtained. A frequent but less definite and reliable sign of bronchiectasis was the accentuation of the bronchial markings in the basal and peripheral lung fields. This is especially significant when observed just above the diaphragm and in the costophrenic sul-

cus. A less common but nevertheless dependable sign of bronchiectasis was a pneumonia recurring in the same area of the lower lung fields after an interval of a few weeks or months. Another type of change noted was the occasional occurrence of a shrunken, contracted area in the basal or lower medial lung fields. Bronchographic examination showed dilated bronchial radicles closely packed against the mediastinum or the dome of the diaphragm.

Analysis of results revealed that bronchiectasis as demonstrated by bronchography could be predicted with reasonable accuracy from a study of the prebronchographic roentgenograms. A fairly close correlation was obtained in 32 cases with frank bronchiectasis, in 21 with minimal or questionable bronchiectasis, and in 26 where no bronchiectasis was discovered. There was a tendency to suspect bronchiectasis somewhat more frequently than confirmation could be obtained bronchographically. It seems advisable, therefore, to seek bronchographic confirmation of a diagnosis of bronchiectasis, however strong the suspicion for such a diagnosis may have been from previous clinical roentgen studies.

CLARENCE E. WEAVER, M.D.

Prevention of Bronchiectasis. Louis H. Clerf. *Pennsylvania M. J.* 47: 676-680, April 1944.

Iodized oil has played an important role in the detection and mapping of areas of bronchial dilatation in the lungs. While extirpation of a lobe is sometimes an effective cure, it can be used only in selected cases and is of no help to a large group who are poor surgical risks.

Although a congenital form is described, bronchiectasis is most commonly caused by bronchial obstruction with atelectasis and infection. Thick secretions are the most common cause of bronchial obstruction in children. A foreign body lodged in a bronchus for a period of time will cause certain residual pulmonary changes and bronchiectasis may be an end-result. The degree of change is in proportion to the amount of obstruction, its duration, and the amount of infection that exists.

Whenever there is a question as to the cause of bronchial obstruction, roentgen examination and bronchoscopy should be done and appropriate treatment instituted.

JOSEPH T. DANZER, M.D.

Boeck's Sarcoid and Systemic Sarcoidosis (Besnier-Boeck-Schaumann Disease): Study of 35 Cases. David Reisner. *Am. Rev. Tuberc.* 49: 289-307, April 1944.

This, the first of two articles on the subject, deals primarily with clinical and roentgen observations of Boeck's sarcoid and systemic sarcoidosis, based on a study of 35 cases in which the clinical diagnosis could be substantiated by histologic examination of one or more biopsy specimens. Seven of the patients died in the course of observation and 4 of these came to autopsy. There were 11 males and 24 females in the series; 30 of the patients were Negroes and 5 were white, this preponderance of the Negro race being out of proportion to the racial composition of the total population of the institutions from which the material was drawn. The youngest patient was eight years old but the majority were between twenty and twenty-nine years. It thus appears that the disease occurs chiefly in young adults, which is in agreement with the experience of others.

While available evidence indicates that sarcoidosis is essentially a widespread disseminated disease, the systemic character is not always manifest clinically. In the more common cases pulmonary involvement and associated systemic lymphadenopathy represent the most conspicuous clinical findings. Such involvement may occur, also, in association with lesions in various other organs, as the eyes, lacrimal glands, parotid glands, spleen, liver, etc. One of the most prominent and constant clinical features of sarcoidosis is involvement of the lymph nodes in various parts of the body, and this was observed to a greater or less degree in all cases of this series. Of the peripheral nodes, those in the cervical, axillary, and inguinal regions were most commonly involved. Involvement of the intrathoracic lymph nodes is a most striking finding and usually exceeds in degree the enlargement of the peripheral nodes. Thirty of the cases in this series showed definite roentgen evidence of such mediastinal node enlargement. The involvement is usually bilateral and often symmetrical, ranging in extent, as seen roentgenographically, from a moderately prominent mediastinal or hilar shadow to massive densities projecting for a considerable distance into the pulmonary field. Such lymph node involvement in general causes no subjective local symptoms or physical signs. In some instances dyspnea of varying severity and, on occasion, wheezing may be present. The involved lymph nodes show a tendency to spontaneous regression, which is particularly striking in cases showing mediastinal adenopathy.

Involvement of the lungs occurred in all but two of the author's 35 cases. In a large proportion the pulmonary changes were discovered on routine chest roentgenograms, with no symptoms present referable to the lungs. At most, the symptoms were mild. Three types of pulmonary changes were observed: (1) Diffusely disseminated changes consisting of discrete small nodular foci resembling those in acute miliary or chronic forms of hematogenous tuberculosis. (2) Either diffuse or localized changes of a linear or strand-like character, giving rise to prominent root trunks and peripheral markings. These lesions are rather similar to the pulmonary changes observed in silicosis, in vascular congestion, and in lymphangitic carcinomatosis. (3) In five cases the pulmonary changes consisted of a patchy coalescent density having the appearance of conglomerate fibrotic induration, usually in combination with widespread changes of linear or discrete nodular character.

The type of lesion showing the most striking tendency to spontaneous regression was the disseminated nodular or miliary form. In about one-third of the cases, progression of the lesion in the lungs occurred during the course of observation. In 3 cases there was evidence indicative of the development of progressive caseous and destructive pulmonary tuberculosis which eventually resulted in a fatal termination. In some cases the pulmonary lesions remained stationary over a period ranging from two to ten years. These lesions were predominantly fibrotic in character. It seems evident, therefore, that during some phase of the disease the pathologic changes may be of a reversible nature and thus striking regression may occur. The variation in the roentgenologic appearance during the later phases of the disease appears to be due to varying degrees of fibrotic induration of the lung. In other instances transformation into frank tuberculosis occurs.

Seven case reports are included, with illustrative roentgenograms of the lungs. L. W. PAUL, M.D.

Solitary Circumscribed Tumors of the Lung. T. F. Thornton, Jr., W. E. Adams, and R. G. Bloch. *Surg., Gynec. & Obst.* 78:364-370, April 1944.

This report deals with a group of 23 cases characterized by single rounded pulmonary lesions arising in the smaller peripheral bronchi, measuring 2 cm. or more in diameter. Such tumors comprise about 25 per cent of primary lung neoplasms.

There is no typical symptomatology. Cough and hemoptysis are uncommon, each occurring in only 5 cases in the present series. Weight loss, anorexia, and weakness are important features, and chest pain is not infrequent, indicating the silent progression of the disease to a relatively advanced stage before medical advice is sought. Clubbing of the fingers was noted in 5 cases.

Physical examination is often negative, but may be of value in revealing a primary neoplasm responsible for a solitary lung metastasis or metastatic foci originating from a primary intrathoracic tumor.

X-ray examination discloses a solitary, dense, rounded, sharply circumscribed mass, occasionally with a fluid level. The appearance may be confused by proximity of the mass to the chest wall or mediastinum.

Of the 23 cases, 17 were malignant tumors, of which 14 were primary and 3 metastatic (2 from the kidney and one from the uterus). There was one benign tumor, a hemangioma. In 4 cases the lesion proved to be tuberculous, and in one a chronic abscess. Thus, most of the solitary "cannon-ball" tumors in this series were primary malignant tumors, chiefly carcinomas.

Preoperative diagnosis is extremely difficult. Only 11 of the 23 patients were admitted directly to medical or surgical chest clinics. In only 6 cases was there any certainty as to diagnosis before operation. The most common error was in the diagnosis of tuberculosis. However, the presence of calcium deposits should give a clue as to the tuberculous nature of the process. Every lesion was demonstrable by x-ray examination. Bronchography was helpful in several instances, but bronchoscopy yielded only 2 positive diagnoses in 12 cases so studied. The authors believe that exploratory thoracotomy is indicated because it provides accurate diagnosis and in suitable cases leads to immediate treatment. Diagnosis was established in 10 cases by this method.

The results of treatment are discouraging, as would be anticipated from the late onset of symptoms. Of the 17 patients with malignant tumors, only 2 are living and apparently well, one ten and one twelve months after surgery, despite the tendency of the primary carcinomas to be highly differentiated. This emphasizes the importance of x-ray examination of the chest in every case of unexplained weakness and weight loss, followed by early thoracotomy in those cases presenting a solitary tumor. JOSEPH SELMAN, M.D.

Roentgenological Changes in the Esophagus in Tuberculous Mediastinitis. Lloyd E. Hawes. *Am. J. Roentgenol.* 51:575-584, May 1944.

The differential diagnosis between mediastinal tumor and mediastinal infection is often difficult for the roentgenologist as well as for the clinician. The only

roentgenologic change may be widening of the mediastinal shadow without parenchymal lung disease. Examination of the barium-filled esophagus in addition to the usual chest roentgenograms has given promise of furnishing considerable differential aid. Five cases of active mediastinal tuberculosis are cited and in each case the value of esophageal study was confirmed.

In one case there was flattening of the esophagus with displacement and an irregular mucosal pattern. In another, roentgen examination revealed multiple adhesions to the esophageal wall and a short fistula into the mediastinum. Another patient showed narrowing of the esophagus with a large pressure defect from a mediastinal mass with adhesions to the wall and irregular mucosal pattern. In a fourth case involvement of the esophagus in the inflammatory process was shown by the intimate adherence of the esophagus to the left main bronchus, which produced a pressure defect. A fifth patient showed multiple fine adhesions of the esophagus at the level of enlarged nodes with some irregularity of the mucosal pattern and two small pressure defects.

Tuberculous mediastinitis usually develops from infection in the tracheobronchial lymph nodes, and infrequently from rupture of a tuberculous focus in the spine, sternum, pericardial or pleural cavity. Active pulmonary tuberculosis is the most frequent source. In older patients the cause may be the breaking down, or reactivation, of an old calcified or scarred mediastinal node. Tuberculous tracheobronchitis rarely gives rise to mediastinitis. After infection of the mediastinal connective tissue, the resulting adhesions and scars may pull upon and stretch the esophagus, or a scar or part of an inflammatory mass may wholly or partially encircle the esophagus and lead to stenosis or a small area of rigidity in its wall. Occasionally there is tubercle formation in the wall; ulceration and rupture into the esophagus may occur. The best known example of the effect of an adhesion on the esophagus is the traction diverticulum.

CLARENCE E. WEAVER, M.D.

Pneumopericardium in a Forty-Two Day Old Infant. D. J. Lages Netto. *Am. J. Dis. Child.* 67: 288-289, April 1944.

The author reports a case of pneumopericardium in a Negro female infant, associated with bronchopneumonia, demonstrated roentgenographically and proved at autopsy. A layer of air surrounded the heart, separating it from the pericardium. There were pneumonic foci in the lung parenchyma and two large abscesses in the right lower lobe. When the larger abscess, which was in intimate contact with the pericardium, was opened postmortem, it was noted to be in communication with a fairly large bronchial tube. This relationship probably explains the origin of the pneumopericardium.

Following a difficult delivery the child had received Vitamin K and 20 c.c. of blood injected intramuscularly into the buttock. A small abscess developed at the site of injection with eventual formation of a fistula extending into the rectum. Hematogenous spread of this infection was believed to be responsible for the subsequent pneumonia.

LESTER M. J. FREEDMAN, M.D.

Foreign Bodies in and about the Heart. Edward F. Bland. *Am. Heart J.* 27: 588-600, April 1944.

The author reports the clinical and roentgen findings in 4 of 8 patients from the North African war zone

with penetrating chest wounds and retained foreign bodies in or in close proximity to the heart.

In the first case a sharp-nosed bullet was embedded for two-thirds of its length (total 2.3 cm.) in the right side of the heart, either in the wall or in a greatly thickened pericardium. In the second case a metallic foreign body from an exploded antipersonnel mine lodged just above the apex of the heart, presumably in the wall of the left ventricle. The third patient was wounded by mortar shell fragments, and subsequent roentgen examination showed a rounded foreign body in the lung, about 1 cm. behind the heart, near the left auricle. In the fourth case multiple fragments in the heart wall and lung were traced back to a hunting accident seven years earlier, when the patient was shot in the chest. The bullet was removed at the time and the retained foreign bodies were believed to be bits of a zipper shattered by the impact of the missile.

Pericardial and pleural effusions developed in the first and second cases, but resolved. In the third case there was a transient pneumopericardium. The intracardiac foreign bodies were seen to move with the pulsations of the heart, while those within the lung moved with respiration.

Electrocardiograms revealed slight right axis deviation in Case 1, changes consistent with injury to the region of the cardiac apex in Case 2, and slight abnormalities in the T-waves in Case 3.

None of the foreign bodies was removed, but the course in each instance was favorable, indicating the ability of the heart to withstand physical injury and even to tolerate sizable slugs of metal within and adjacent to its walls.

The author briefly mentions 4 other cases: (1) a bullet lodged against the aorta; (2) two fragments in the heart muscle, one anteriorly in the region of the aortic orifice and one posteriorly near the junction of the left auricle and ventricle; (3) a jagged metallic fragment at the lower border of the heart, in the region of the right ventricle; (4) a fragment of metal in the right auricle.

HENRY K. TAYLOR, M.D.

THE DIGESTIVE SYSTEM

Correlation of Roentgenologic and Gastroscopic Examinations from the Standpoint of the Gastroenterologist. R. J. F. Renshaw. *Am. J. Roentgenol.* 51: 585-591, May 1944.

The author has reviewed 938 consecutive gastroscopic examinations made on 842 patients. In 217 patients, or 25.6 per cent, the gastroscopic examination was of major value as compared to the roentgenologic. In 150 patients, or 17.7 per cent, the diagnosis was established by gastroscopy when other methods had failed. Most of these were cases of chronic gastritis. In 67 patients in whom the roentgenologist suspected gastric ulcer or cancer, the gastroscopist could state definitely that no organic disease was present. The gastroscopic examination was of secondary or confirmatory value in 55.4 per cent; it was of no value in 19 per cent. In 58 cases the gastroscopist failed to discover a lesion or an area where the roentgenologist suspected or demonstrated its presence.

Gastroscopy has certain definite limitations. The Schindler-Cameron gastroscope contains 54 lenses. If for anatomical reasons the instrument is flexed beyond 42°, the image is not transmitted from one lens to

the next. Esophageal or gastric spasm may render the examination incomplete. The gastroscopist sees a moving picture and what may be seen at one movement may not be visualized again. Gastroscopic blind spots include an area at the tip of the instrument, extending over the greater curvature; the lower anterior and posterior walls opposite the incisura angularis; the posterior wall of the body immediately adjacent to the instrument; the extreme upper portions of the lesser curvature; and a large portion of the fornix. Inconstant blind areas include the pylorus and lesser curvature of the antrum. In only 118 cases, however, was the examination totally unsatisfactory because of technical reasons. "Progress" or repeated gastroscopic examinations are often desirable, since an unsatisfactory examination on one occasion does not mean that all subsequent studies will be indeterminate.

A comparison of roentgenologic and gastroscopic diagnoses in a series of proved cases revealed that, while the roentgenologic examination is still the most valuable single examination, the gastroscopist is no more likely to make the correct diagnosis or to err in judgment than the roentgenologist. Likewise, in the matter of differentiating between a malignant and benign lesion, the gastroscopist is not superior to the roentgenologist.

Certain cases cannot be considered as having been adequately studied unless a gastroscopic examination has been done. The diagnosis of chronic gastritis is chiefly the gastroscopist's prerogative.

CLARENCE E. WEAVER, M.D.

Congenital Atresia of the Esophagus, with Tracheo-Esophageal Fistula: Transpleural Operative Approach. Albert O. Singleton and Maynard D. Knight. *Ann. Surg.* 119: 556-571, April 1944.

The authors have covered well a highly technical surgical problem, with a discussion of the various procedures suggested for its correction.

Esophageal anomalies are of three types: (1) complete absence of the esophagus, which is rare; (2) a blind upper and a blind lower segment, with no tracheal communication; (3) atresia associated with a fistulous opening into the trachea. This third type is further subdivided according as the fistulous communication is from the upper segment (type 3A), the lower segment (type 3B), or both (type 3C). Of the various types, 3B—a blind upper segment with a tracheal fistula from the lower segment—is most common, accounting for 70 to 80 per cent of all cases.

The symptoms are constant and diagnostic: drooling, with excessive amounts of mucus and saliva, and attacks of choking and cyanosis, precipitated by attempts at feeding. In types 1, 2, and 3A, a plain film of the abdomen shows absence of gas in the bowel, while in types 3B and 3C its presence can be demonstrated. Diagnosis is helped by introduction of a soft rubber catheter, which will encounter obstruction 10 to 12 cm. from the alveolar margin. Barium should not be used as a contrast medium. Lipiodol or diodrast may be employed and is essential for the diagnosis of types 3A and 3C; it should be aspirated, however, immediately after the films are made.

Associated anomalies, as for example imperforate anus, are common but are seldom incompatible with life.

The authors discuss the anatomical and embryo-

logic aspects of these anomalies and review the literature of treatment, with its long record of failures. They favor a transpleural operation, with closure of the fistula and primary anastomosis of the two esophageal segments, when possible. When the length of the segments will not permit anastomosis, cervical esophagotomy and occlusion of the lower end are the next alternative. In either instance a preliminary gastrotomy should be done.

Four cases, all terminating fatally, are recorded. In two of these the authors employed the transpleural procedure. In one, in a premature infant, the distance between the segments of the esophagus proved too great for approximation of the ends. In the other, with a fistula from the lower segment, the operation was successfully completed and the child lived over seven months. The introduction of bougies over a silk thread was carried out after the third week in an attempt at dilatation. Unfortunately the thread was inadvertently cut at about seven months and an attempt was made to replace it by another, to which a small piece of lead was attached. Death followed as a result of pneumonia. Autopsy revealed a second fistula in the upper segment of the esophagus in which the piece of lead had become entangled, resulting in enlargement of the opening and the development of pneumonia. The authors believe that this fistula, had it been discovered earlier, might have been repaired without difficulty.

An interesting discussion follows this paper. In his remarks, Doctor Ochsner emphasizes the importance of operating through the right rather than the left hemithorax.

V. A. LOOKANOFF, M.D.

Achalasia of the Esophagus. Ralph F. Niehaus. *J. Iowa M. Soc.* 34: 145-148, April 1944.

Forty cases of achalasia of the esophagus were seen at the State University of Iowa Hospitals between 1929 and 1939. In 5 instances a malignant neoplasm was subsequently discovered, although on roentgen examination and esophagoscopy the condition was diagnosed as achalasia. This represents an error of 13 per cent.

The author stresses the importance of differentiating achalasia from carcinoma of the lower end of the esophagus or fundus of the stomach, and secondly, of excluding carcinoma as a complication in achalasia itself.

E. W. GODFREY, M.D.

Gastric Emptying Time of Man at High and Normal Environmental Temperatures. Austin Henschel, Henry Longstreet Taylor, and Ansel Keys. *Am. J. Physiol.* 141: 205-208, April 1944.

Gastric emptying times were observed on 17 normal men, eighteen to twenty-eight years of age, in rest at environmental temperatures of 77° F. and 120° F.

The subjects reported for examination in the morning without breakfast. After one-half hour of rest in air-conditioned rooms, a standard barium meal, consisting of 4 ounces of cooked oatmeal to which 2 teaspoons of sugar and 2 ounces of barium sulfate were added, was eaten as rapidly as possible. Five minutes after starting the barium meal the first x-ray picture was taken. The second film was taken at one hour and from then on the progress of the meal was followed by fluoroscopy at fifteen-minute intervals. Roentgenograms were taken whenever a decided change in the

size of the stomach shadow was observed. The final emptying time was confirmed roentgenographically. Examinations were made in the standing position. Between observations the subjects remained seated.

The gastric shadows were traced onto paper from the developed x-ray films, and the areas of the shadows were measured with a planimeter. All the gastric areas were expressed in per cent of the area at five minutes after taking the barium meal.

In all but one of the subjects the gastric emptying time was faster at the higher temperature. In 12 subjects the average decrease in emptying time was 30 per cent. Decreased appetite in hot weather, therefore, cannot be attributed to decreased gastric motor function. Observations on about 100 normal men doing hard work at 120° F. failed to indicate any lack of appetite or any signs of decreased gastric activity except in actual heat exhaustion.

Hypertrophic Pyloric Stenosis in Adults. Howard Wakefield. *Gastroenterology* 2: 250-257, April 1944.

A case is reported of hypertrophic pyloric stenosis in an adult with a long history of vomiting and nausea. X-ray examination revealed a stenotic lesion of the stomach, which was successfully resected.

The author quotes rather extensively from the literature and states that evidence is gradually accumulating which favors the view that in some cases the symptoms of pyloric stenosis of infancy may go on to adult life before they produce a serious problem, but it is not clear that this was true of his case. The greatest help in diagnosis is a history of nausea and vomiting of many years' duration plus x-ray studies of the stomach showing the long pyloric canal described by Kirklin. Histologic examination of the excised tissue is essential.

Roentgen Visualization of Tumors of the Cardia. Milton G. Wasch and Bernard S. Epstein. *Am. J. Roentgenol.* 51: 564-571, May 1944.

The most reliable index for the correct diagnosis of tumors of the cardia is a clear demonstration of the tumor itself. Sometimes the existing stomach bubble is sufficient for this purpose. The authors have been able to produce contrast roentgenograms of the cardia by inflating the stomach through a Levin tube under fluoroscopic control, using the hand bulb from a blood pressure apparatus. The insufflation may be made with the stomach empty or partially filled with barium. Films are made in various positions. Precautions should be taken to avoid interpreting extraneous shadows as intrinsic gastric masses. Among these are the shadows of an overlying spine, of an enlarged left ventricle, a high retroperitoneal tumor, an exudate in the left lumbar region, and, in rare instances, an aneurysm of the upper abdominal aorta. An enlarged left lobe of the liver may offer some difficulty but may usually be identified by the smoothness of its borders, its lingual contour, and its continuity with the main hepatic mass.

Case reports and roentgenograms are furnished to illustrate some of the tumors of the cardia demonstrable by this method.

This paper serves to call to our attention the necessity of careful examination of the cardia and gives a helpful method of demonstrating lesions which can be and often are overlooked in routine gastric examinations.

CLARENCE E. WEAVER, M.D.

Sarcoma of the Stomach. Arthur E. Porritt, K. E. A. Hughes, and R. J. C. Campbell. *Brit. J. Surg.* 31: 395-398, April 1944.

A soldier, aged 27, gave a long history of gastric distress characterized chiefly by pain half an hour after meals. A large mass was visible and palpable in the left epigastrium and hypochondrium. There was a moderate secondary anemia and a fractional test meal revealed absence of free hydrochloric acid and traces of blood in each specimen. The roentgenographic examination was limited by the patient's intolerance of barium. The stomach was not freely movable and peristalsis was absent. The lesser curvature was irregular and the appearance suggested displacement forward and to the left. A well defined mucosal pattern supported a diagnosis of extragastric neoplasm and was against carcinoma of the stomach.

At operation a large gastric tumor of hard rubbery consistence was found involving the entire lesser curvature, adherent to the left lobe of the liver and spreading through the lesser peritoneal sac up into the transverse mesocolon. Pieces of the growth removed for pathological study showed round-cell sarcoma. An occasional spindle cell suggested an origin from muscle.

Death occurred seventeen days after operation and autopsy revealed involvement of almost the entire stomach, limited by the cardiac and pyloric orifices. The tumor was adherent to and appeared to be invading the left and caudate lobes of the liver and a perforation had occurred in this area, partially sealed off by the liver. Perforations are said to be more common than with carcinoma.

The abdominal lymph nodes were not involved with the exception of an isolated node in the transverse mesocolon. There were no hepatic metastases.

MAX CLIMAN, M.D.

Errors in the Diagnosis of Intestinal Obstruction Robert N. Bartels and Karl S. Harris. *J. Iowa M. Soc.* 34: 138-142, April 1944.

Five cases presenting the characteristic symptoms and signs of acute mechanical intestinal obstruction are reported. In this group the history, clinical, and roentgen findings were all in accord with such a diagnosis, yet surgical exploration revealed no evidence of obstruction.

In the first case, a roentgenogram showed air and fluid levels in the small bowel. At operation a segment of small intestine appeared somewhat distended, edematous, and stippled on handling. Peristalsis was present in this region and the blood supply to the gut was normal. It is suggested that the obstruction was due to volvulus, with spontaneous release.

Roentgen examination of the second patient revealed dilatation of the small and large bowel with gas. At operation, four hours after the roentgenograms were taken, the small bowel was collapsed and normal. The authors suggest that this may be classified as intestinal obstruction due to enterospasm.

Films of the third patient, an elderly male, showed a greatly dilated colon and some small bowel dilatation, with evidence of fluid levels. At operation a diagnosis of annular carcinoma was made because of constriction and thickening at the rectosigmoid, and a cecostomy was done. The patient went rapidly downhill. At autopsy no obstructive lesion of the bowel could be found. This case is classified as obstruction due to colonic spasm.

In the fourth case roentgenograms revealed dilatation of the large gut. Following exploration the diagnosis was changed to megacolon.

Films of the last patient showed large bowel distention. A diagnosis of carcinoma of the sigmoid was made because of an obstructive lesion demonstrated by barium enema. At operation no lesion was found. This also was thought to be a case of intestinal obstruction due to colonic spasm.

While it is generally recognized that negative x-ray evidence in plain roentgenograms may not rule out the possibility of intestinal obstruction, the absence of operative findings in cases in which the history, clinical, and roentgen findings concur is unusual.

E. W. GODFREY, M.D.

Small Intestinal Disorders in Avitaminosis. Norman Learner, Herbert M. Stauffer, and Charles L. Brown. *Ann. Int. Med.* 20: 675-685, April 1944.

The authors review the experimental and clinical evidence presented by various authorities indicating that deficiency states are accompanied not only by disturbed gastro-intestinal motility but also by defective absorption of essential food factors and vitamins.

Mackie in 1933 (*M. Clin. North America* 17: 165, 1933) reported the roentgen findings in the small bowel in a case of non-tropical sprue, and these were established by subsequent investigators as a constant feature of the sprue syndrome. The changes, which tend to disappear with clinical improvement, consist in disturbed motility with accumulation of quantities of the contrast material in loops that appear dilated and smooth, the so-called "moulage" effect. Between these loops are segments empty of barium, giving the impression of alternating areas of reduced tone and spastic areas. A striking feature of the more advanced cases is the presence of gas and fluid levels in the dilated loops, simulating intestinal obstruction.

More recently a similar roentgen picture has been observed in other deficiency conditions, and Lepore and Golden (*J. A. M. A.* 117: 918, 1941) have described a syndrome due to vitamin B deficiency characterized by reversible changes in the small bowel pattern. Radiologically, this "deficiency pattern" includes hypermotility and hypertonicity in the early stages; hypomotility and dilatation in the advanced cases; abnormal segmentation, and coarsening or obliteration of the mucosal pattern, with flocculation of barium.

Two cases illustrating the roentgen changes in deficiency states are presented. The first patient showed mild changes which improved upon therapy; in the second the changes were severe and apparently irreversible.

The roentgen picture of avitaminosis is not specific. Gastro-intestinal allergy may produce changes in intestinal motility, demonstrable by x-rays, as may emotional disturbances. Hypocalcemia may affect the small bowel pattern, and altered intestinal motility has been described in diabetes insipidus and nephrosis. Patients with portal cirrhosis or an obstructive carcinoma may also show an abnormal pattern. If the roentgenological changes are mild, they cannot be distinguished from normal variations, since no extended series of complete small intestinal studies in normal subjects has been published. Modifications in the pattern even of the same patient may occur from time to time under the influence of emotional or other

factors. Recent work has indicated, furthermore, that the healthy child may normally show a "deficiency pattern."

In spite of these obvious limitations to the dependability of the "deficiency pattern" as a criterion of vitamin B deficiency, the authors believe that patients with "functional" gastro-intestinal disorders in whom such a pattern is demonstrable should be given a trial of vitamin B therapy. This should be in the form of yeast by mouth and crude liver extract parenterally, with supplemental use of other components of the vitamin B complex.

A useful bibliography is appended.

STEPHEN N. TAGER, M.D.

Annular Pancreas. A Tabulation of the Recent Literature and Report of a Case. Bert E. Stofer. *Am. J. M. Sc.* 207: 430-435, April 1944.

The incidence of annular pancreas is approximately one in every 2,500 autopsies. Less than 50 cases had been reported up to 1943. A new case, the third from the author's hospital, is here recorded.

A psychotic white male, aged 62, had been vomiting several times daily for six months prior to admission. Roentgen examination revealed an abnormality of the second portion of the duodenum which was interpreted as being due to a diverticulum. At autopsy an annular pancreas was found, causing an hour-glass deformity of the duodenum. The ring of pancreatic tissue was complete, although a small part was composed of fibrous tissue. As is usual in this condition, there was no apparent connection between the main pancreatic duct and the duct of the annular portion. This supports the theory that annular pancreas is an abnormal development of the ventral pancreatic anlage rather than a localized hypertrophy of a normally formed pancreas. Other congenital malformations, especially in the gastro-intestinal tract, are frequently associated. Cerebral malformations were found in the author's patient.

This case is the third of the seven reported in the past ten years in which an erroneous diagnosis of duodenal diverticulum was made. Usually the second and third portions of the duodenum are involved. A constriction at the involved site is the usual deformity.

BENJAMIN COPELAND, M.D.

Clinical Value of Cholangiography. Dean Macdonald. *Can. M. J.* 50: 349-351, April 1944.

X-ray study of the biliary ductal system with the aid of a contrast medium is of value in obtaining information concerning calculi, strictures, and biliary fistulae. The author prefers diodrast 35 per cent, although a 17.5 per cent solution may be employed in thin patients. Hippuran was found to give too faint a shadow, while lipiodol was too heavy and thick, tending to "blot out" small calculi.

For delayed or postoperative cholangiography, the diodrast solution is heated to body temperature. After the withdrawal of bile, 3 to 10 c.c. of the solution, depending on the size of the common duct, are injected slowly into the drainage tube and barbotaged into the duct and radicals, with care not to introduce any air. The procedure is best done with the patient in the Trendelenburg position. Morphine (gr. 1/6) is sometimes given fifteen minutes or half an hour before the first film is made to increase the resistance of the sphincter of Oddi and prevent too rapid emptying.

Several exposures are made until filling is complete. The patient is then placed flat or in a reversed Trendelenburg position and given amyl nitrite inhalation. Three exposures are then made at intervals of thirty seconds, two minutes, and ten or fifteen minutes. If the gallbladder is still *in situ*, the patient should be rotated to prevent obscuring of the ducts by its shadow. Good emptying of the duct system does not exclude the presence of calculi, since a stone may be present without causing obstruction.

Roentgen examination during operation, or immediate cholangiography, is regarded by the author as the method of choice, at least theoretically, although in his experience it has not yielded the good results reported by others. It is especially valuable for the determination of residual calculi and in secondary operations where scarring and adhesions make digital examination of the common duct difficult.

LESTER M. J. FREEDMAN, M.D.

THE PERITONEUM

Post-Operative Pneumo-Peritoneum. J. E. Bannen. Brit. J. Radiol. 17: 119-121, April 1944.

Pneumoperitoneum occurs to some degree after every laparotomy, the air usually being absorbed within seven days. With the patient in Fowler's position, the free air rises to the subdiaphragmatic regions and is demonstrated roentgenographically as an aerated space 1 or 2 inches in depth, separating the diaphragm from the liver and stomach. Frequently the upper pole of the left kidney can be clearly seen through the air-filled cupola of the left diaphragm. The clinical signs are few: cough, chest pain, and perhaps respiratory embarrassment, but these are not typical.

There are two probable causative factors of pneumoperitoneum following operation: the opening of the peritoneal space to air and the habit of many surgeons of pulling the abdominal wall up when putting in the last sutures, thus increasing the air content of the abdomen. Larger quantities of air are found after pelvic operations.

Pneumoperitoneum may be responsible for certain post-operative pulmonary complications, as it adds to the embarrassment of the already handicapped respiration. This is particularly true when the patient is in the Fowler position. So-called "gas pains" may be due to excessive air in the peritoneal cavity.

In making the diagnosis by x-ray, subdiaphragmatic abscess must be differentiated. This is usually unilateral; it may show a fluid level and an inflammatory zone in the adjacent lung.

SYDNEY J. HAWLEY, M.D.

THE SKELETAL SYSTEM

Neurofibromatosis of Bone. Murray M. Friedman. Am. J. Roentgenol. 51: 623-630, May 1944.

Neurofibromatosis is characterized by a proliferation of the tissues composing the peripheral nerves, including both the axis cylinders and their sheaths. The overgrowth may take place along the course of the nerve, produce a general thickening of the nerves, or involve their peripheral terminations. Brooks and Lehman (Surg., Gynec., & Obst. 38: 587, 1924. Abst. in Radiology 3: 455, 1924) attribute the bone changes in this disease to the development of a neurofibroma in

one of the periosteal nerves. As the tumor enlarges, pressure is exerted on the bone cortex, causing erosion and pit formation. These depressions are filled with neurofibromatous tissue. In the roentgenogram they sometimes take on the appearance of cysts and at times a thin shell of cortex covers the fibrous tissue. No actual infiltration of the bone substance by neurofibromatous tissue has been demonstrated. The disease is considered to be hereditary in character. Nørgaard (Acta radiol. 18: 460, 1937) is of the opinion that differences in the length of bones can be accounted for on the basis of an embryonal defect, while Moore (J. Bone & Joint Surg. 23: 109, 1941) finds strong evidence that overgrowth is the result of a segmental relationship between the affected nerve and the bone. Scoliosis is found frequently in neurofibromatosis. This is a kyphoscoliosis, the usual site of which is the lower portion of the thoracic spine.

Four cases of neurofibromatosis with bone involvement are presented. Two showed pedunculated tumors of the skin. In one kyphosis was the principal bony abnormality. In another there were defects in the skull, scoliosis of the spine with erosion of the fifth lumbar segment, shortening of one leg, and widening of the tibial shaft by the formation of irregular cortical and subperiosteal new bone. The third case was a localized form involving the mandible. In a fourth patient there was unilateral involvement of the left half of the pelvis and bones of the lower extremity by an osteosclerotic process. The lower end of the femur was widened. The cortex of the shaft was thickened and there were cyst-like areas at the lower end of the shaft. The cortex of the tibia was thickened. This patient had a definite asymmetry of the face, body, and limbs. Neurofibromatous tissue was demonstrated in the marrow cavity of the femur, which suggests that nervous tissue must be present in bone marrow. Sclerosis of bone in the femur and tibia was thought to have been caused by neurofibromatous tissue in the marrow cavity as microscopic examination of the cortical bone showed no recognizable changes.

CLARENCE E. WEAVER, M.D.

Symposium on Low Back Pain. Spondylolisthesis Analysis of 59 Consecutive Cases. Guy A. Caldwell. Ann. Surg. 119: 485-494, April 1944.

While the author entitles his paper "Spondylolisthesis," he includes not only cases of forward slipping of the vertebra but also those defects of the neural arch in which slipping is not demonstrable (prespondylolisthesis or spondylolysis). As indicative of the frequency of these conditions as a cause of low back pain, he reports that, of 152 patients with the latter complaint, 10 per cent were found to have neural arch defects, while among 82 from the same group who were referred for orthopedic study after other causes had been ruled out, 18 per cent had spondylolisthesis or spondylolysis. The present report is based on a series of 59 cases seen in a period of twenty-two months. Twenty-seven of the group gave a history of trauma.

The physical findings in spondylolisthesis and spondylolysis vary. Typical shortening of the back, prominence of the buttocks and iliac crest, and abrupt stepping-off of the spine at the level of the spinous process of the fifth lumbar vertebra are present only in spondylolisthesis of grades III and IV. In none of the author's series, which included only cases of spondylolysis and spondylolisthesis of grades I and II, was displacement of

the vertebra sufficient to be recognized by inspection or palpation.

The diagnosis of these earlier cases is dependent upon the roentgen examination. This demands the most painstaking technic, with at least three views as a routine: (1) a direct anteroposterior view; (2) a true lateral view focused on the fifth lumbar vertebra; (3) a 35-degree anteroposterior view with the rays directed toward the head and centered between the sacrum and the fifth lumbar vertebra. For the confirmation of unilateral defects, a 45-degree oblique lateral film may also be required.

Of the author's 59 patients, 16 had spondylosis, and in 9 of these the defect was unilateral. Of the 43 cases of spondylolisthesis, 37 were of grade I and 6 of grade II.

The symptoms of spondylolisthesis have been attributed by most observers to progressive displacement of the vertebral body with consequent dragging upon the supporting muscles, ligaments, and nerve roots, though some few question this view. The author is among the latter group. He believes that progressive narrowing of the intervertebral disk with degenerative changes in the disk and proliferative bone changes in the neighborhood of the intervertebral foramina may explain all of the symptoms and signs generally seen.

Operative treatment, consisting in spinal fusion of various types, has in general been regarded as the most effective treatment. The author believes that conservative measures are worthy of more consideration. Among 23 of his series in which treatment consisted in the application of a brace or corset, without operation, the results after ten to eighteen months were "good" in 7, *i.e.*, the patient was relieved of pain while wearing the support and was able to perform light work; "fair" results were obtained in 12 (partial relief of pain only). Eight cases were treated by spinal fusion, with good results in 3 and fair in 1. The author favors a simplified type of operation, consisting in fusion of the lumbosacral articulation alone rather than an attempt to establish a bridge from the third lumbar vertebra to the sacrum with a bone graft. One case is reported in which there was sciatic pain, found to be due to incarceration of the nerve root in proliferated bone. From observation of this case it is concluded that when spondylolisthesis is associated with sciatic pain and roentgenograms reveal a narrow lumbosacral disk with marginal hypertrophic changes, the nerve root should be explored and decompressed when necessary.

The other paper in this Symposium, preceding that by Caldwell, is by Walter E. Dandy, who favors complete or essentially complete removal of the affected disks. An interesting Discussion follows (pp. 494-497).

V. A. LOOKANOFF, M.D.

Diagnosis and Treatment of Spondylitis. A. Raff. *South African M. J.* 18: 98-100, March 25, 1944.

The author classifies spinal arthritis in three broad groups. These are (1) spondylitis ankylopoietica, (2) rheumatoid spondylitis, and (3) spondylitis osteoarthritica.

Of the three types ankylosing spondylitis or spondylitis adolescens (Scott) is considered the most important. It attacks young and athletic men; the onset is slow and progressive and can be recognized five to seven years before the spinal symptoms have developed; it is amenable to treatment and arrest in its early stages. The first radiographic change is decalcification of the bones of the lumbar spine and pelvis. Clinically this corresponds to the stage of "wandering pains."

Later there are obliteration and sclerosis of the posterior and anterior fissures of the sacroiliac joints, sclerosis usually being a sign of high resistance. Subsequently pain and stiffness of the spine become constant features, and the radiographs show the characteristic changes of ankylosis of the spinal segments. The degenerative changes in the sacroiliac joints occur five to seven years before spondylitis. These constitute the "prespondylitis" of Scott, who maintained that if wide field x-ray therapy consisting of fractionated doses of 60-100 r, 1-3 mm. Al filtration, and 100-130-kv.p., is administered, the process can be arrested.

Rheumatoid spondylitis, which is of infectious origin, affects mainly women between the ages of twenty and forty. It is secondary to rheumatoid arthritis elsewhere. Women at the menopause complaining of painful "rheumatic back" and symmetrical swelling of the knees and small joints of the hands and wrists present diagnostic problems. They may be aided by intramuscular injections of ovarian extracts, but the author finds that this is often not enough. He advocates the infiltration of the painful areas with a local anesthetic, along with either local or wide field x-ray therapy for the obstinate cases.

Spondylitis of the osteo-arthritic type is a disease of advancing years and is more common in men. Osteophytes and exostoses with narrowing of the intervertebral spaces are a common finding. The sacroiliac joints are not involved.

Radiographs of the hands and sacroiliac joints, along with the blood sedimentation rate, are valuable in establishing the differential diagnosis and useful as a guide to the progress of the case and the response to treatment.

E. W. GODFREY, M.D.

Lateral Rupture of the Intervertebral Discs: A Common Cause of Shoulder and Arm Pain. R. G. Spurling and Wm. B. Scoville. *Surg., Gynec. & Obst.* 78: 350-358, April 1944.

The authors give an able discussion of the clinical syndrome associated with lateral rupture of the cervical intervertebral disks, basing their observations on a review of the literature and on direct study of 12 cases proved by operation at the Walter Reed General Hospital.

The cervical canal is more completely filled with nervous tissue than either the dorsal or lumbar spine; consequently, any intraspinal mass in that region causes early symptoms of pressure. Moreover, the cervical nerve roots emerge from the dura at right angles and lie immediately over the intervertebral disks so that a lateral protrusion of a disk may compress the root directly against adjacent structures without much damage to the spinal cord itself. The fact that the intervertebral foramina in the cervical region are relatively shallow in their anteroposterior diameters makes the roots especially vulnerable to pressure from small bony spurs or lateral herniations of the nucleus pulposus.

The points of greatest strain in the cervical spine are at the fifth and sixth interspaces, and the disks are frequently narrowed at these levels. Associated with these narrowed disks may be roentgenologic evidence of localized arthritis, but many patients with such x-ray findings have no symptoms referable to the neck or arms.

A history of injury is more frequent in cases in which

the ruptured disk produces actual cord compression than with small laterally placed lesions which cause only arm and shoulder pain. Degenerative processes may play an important part in formation of the lesions, as is indicated by the frequent presence of spurs and narrowing of the disks.

Pain and stiffness of the neck are usually the first symptoms and sometimes are of short duration. The sites of maximum pain are the base of the neck, tip of the shoulder, the arm down to the elbow, and the hand. The pain is often made worse by sudden movements or straining, and may be relieved by change of position. Numbness of the hand with weakness of the whole arm is frequently noted. Numbness and tingling of the hand may be recurrent, without any loss of sensation except in severe and prolonged cases. Pressing on the top of the head, tilted toward the affected side, may demonstrate or aggravate the symptoms described. Muscular weakness, usually of the biceps or triceps, may be present, and the tendon reflexes of these muscles may be weak or absent. There may be spinal tenderness at the site of the lesion and pressure there may reproduce the symptoms.

Neoplastic or inflammatory lesions of the cervical spine, or neoplasms arising in the nerve roots themselves, may give rise to a similar train of symptoms. Compression by the scalenus anticus of the lower portion of the brachial plexus, with or without cervical rib, is commonly confused with a ruptured cervical disk. In the former instance, however, the nerve pain and paresthesias are referred to the ulnar distribution of the eighth cervical and first thoracic instead of the distribution of the sixth or seventh cervical nerves, and since ruptured disks rarely occur below the level of the sixth interspace this serves as a means of differential diagnosis. In disk cases, furthermore, there is no evidence of compression of the subclavian artery. In doubtful cases compression of the neck by flexion toward the affected side with pressure on the head, as previously suggested, will bring out the characteristic symptoms of a disk lesion.

Lateral cervical spine films show narrowing of the intervertebral space, if present, and the oblique films bring out narrowing of the foramina and the presence of osteophytes. Pantopaque myelography is an accurate diagnostic procedure, satisfactory results being obtained following the injection of 6 c.c. of the opaque medium.

In minor cases conservative treatment may be considered, but if muscular atrophy or marked sensory loss is present in the arm, even though no signs of cord compression are present, prompt operative measures are indicated in order to prevent permanent damage to the cervical cord. Mild cases may be treated by a period of bed rest with halter traction, followed if necessary by use of a cervical collar support. Unless relief is obtained in three or four days, more radical measures will probably be necessary. Manipulation of the cervical spine in these cases is a dangerous procedure. Surgical treatment consists of removal of the herniated nucleus, together with any spurs which may be present. All of the authors' 12 patients were relieved of their symptoms within two weeks following operation and when completely healed were returned to military service without disability.

At the Walter Reed General Hospital one case of cervical disk rupture is found to 12 cases of lumbar disk rupture, but as clinical knowledge of the cervical lesion

becomes more widely applied this proportion is likely to change. The majority of patients with cervical disk lesions were over forty years of age, but age seemed of little significance in the lumbar cases. Only 16 per cent of the cervical cases gave a history of trauma, while in the lumbar group 60 per cent gave such a history. Pain and paresthesias radiating from the neck into the shoulder, arm, and hand, and exaggerated by the neck compression test, were found in all the patients with cervical lesions. In every instance the site was at the 5th or 6th cervical level. In one patient both the 5th and 6th disks were affected.

DEWAYNE TOWNSEND, M.D.

Posterior Herniation of the Intervertebral Disc: An Analysis of 65 Cases. Wm. T. Peyton and Jules D. Levin. *Minnesota Med.* 27: 263-272, April 1944.

The authors stress the necessity for follow-up studies in cases of herniation of the intervertebral disk to determine the effects of operation on the symptoms and physical signs. They limit their study to cases involving the lumbar spine. The periods of observation represented vary from eighteen months to five and one-half years. The series includes 65 cases in which laminectomy was performed.

The lesion occurs most frequently in the third, fourth, fifth, and sixth decades. In 50 to 77 per cent of cases, according to different authorities, there is a history of trauma. Outstanding among the physical findings are: loss of the lumbar curve; muscle spasm of the erector spinae group in the affected area; tenderness to deep pressure in the involved area; positive response to sciatic nerve-stretching tests; objective sensory changes.

Roentgenologically, narrowing of the intervertebral space may be demonstrable but this is not conclusive evidence of a herniated disk. Contrast material in the subarachnoid space is essential for definitive information, but this should be employed only after a careful neurologic examination. Lipiodol is the medium preferred; it should be removed after films are made.

The authors state that in recent years they have come to prefer hemilaminectomy or partial hemilaminectomy in the treatment of disk lesions, though in very large or mid-line lesions, bilateral total laminectomy is indicated. Recurrence of a herniated disk at the same site or at another site has been reported. Spinal fusion may sometimes prevent such a recurrence.

As to results, the authors found that backache was completely relieved in about 70 per cent of cases, and partially in another 20 per cent; sciatic pain, complained of in 96 per cent of the cases before operation, was present in only 27.5 per cent postoperatively; the lumbar curve was restored in about 34 per cent of cases; muscle spasm was relieved in about 70 per cent and root pain in an equal number. In other words, relief of major symptoms was obtained in something over two-thirds of the cases. PERCY J. DELANO, M.D.

Neurosurgical Interpretation of Dermatome Hypalgnesia with Herniation of the Lumbar Intervertebral Disc. J. Jay Keegan. *J. Bone & Joint Surg.* 26: 238-246, April 1944.

From clinical and surgical experience with herniated lumbar intervertebral disks, the author has been able to outline definitely the dermatomes of the lower extremity. Contrary to the usual belief, each sensory

nerve has a distinct distribution, and its loss is definitely registered in the change in sensation along a determinable region.

The first sacral nerve, with an intraspinal length of 3 to 4 cm., is the one most frequently involved, as a result of herniation of the fifth lumbar disk. Herniation of the disk compresses this nerve between the ganglion below and the union with the main dural canal above, and hence is not necessarily demonstrable in a myelogram. The herniating disk first elevates and stretches the posterolateral portion of the posterior longitudinal intervertebral ligament, which may explain the early ache or pain in the lower back. The first contact with the nerve root is on the anterior portion, where the motor fibers are located, but it is the subsequent compression of the posterior aspect of the nerve against the ligamentum flavum or lamina which probably accounts for the sensory changes. The fact that the most dorsal sensory fibers of the root are those of the dorsal primary division supplying the mid-gluteal region and the sacroiliac ligament probably explains the constant gluteal pain in these cases and their confusion with sacroiliac disease.

When this nerve root has been compressed long enough or severely enough to produce subjective numbness, or loss of ankle jerk, there can usually be outlined a continuous strip of hypalgesia extending from the little toe to the upper sacral spine, with a small area of analgesia on the lateral border of the foot or on the posterolateral calf. This dermatome hypalgesia can be outlined sharply and is constant in its location; hence it is diagnostic for first sacral nerve-root loss, whatever the cause. It includes only the little toe; does not include the heel; covers the external malleolus; extends up the posterolateral calf, knee, and thigh, with its medial border about at the posterior mid-line; then curves slightly outward over the buttock and mid-gluteal region to the upper sacral spine, where it stops sharply at the mid-line. When this complete dermatome hypalgesia is present, the ankle jerk usually is absent. Lesser degrees of compression of the first sacral nerve root may show the dermatome hypalgesia in only the foot and leg, with the ankle jerk only reduced or varying with use of the leg.

Herniation of the fourth lumbar disk, with compression of the fifth lumbar root, is difficult to diagnose because there is no reflex loss and the sensory changes are not easily found. The characteristic hypalgesia involves the dorsum of the foot including the three middle toes, the anterolateral leg, lateral knee and thigh, curving around the buttock to the spine at the lumbosacral junction. In addition, there is a wedge-shaped area on the sole, from the three middle toes, over the lateral heel, to the Achilles tendon.

Compression of the fourth lumbar nerve root is less common. The dermatome includes the great toe and medial aspect of the foot, the anteromesial aspect of the leg, the patella, and anterolateral aspect of the thigh.

The other dermatomes in this region have not been well established.

In the author's series of 185 cases, first sacral dermatome hypalgesia was found in 116 and the site of the lesion was verified operatively in 64; fifth lumbar dermatome hypalgesia was observed in 47 cases and the site of the lesion was verified in 22. The corresponding figures for compression of the fourth lumbar nerve root were 19 and 11.

Charts are presented defining the areas of sensory nerve distribution in the lower extremities, and the clinical and surgical aspects of low back pain are discussed.

JOHN B. McANENY, M.D.

Observations on the Regeneration of the Semilunar Cartilages in Man. I. S. Smillie. *Brit. J. Surg.* 31: 398-401, April 1944.

Extirpation of a meniscus in animals is invariably followed by replacement by a new structure which resembles the normal cartilage in shape and appearance but is composed entirely of fibrous tissue. There are seven recorded cases of proved regeneration of a meniscus in man. In a series of 600 meniscectomies performed during the past three years, 14 patients were subjected to a second operation because of recurrence of symptoms. The following observations are based on these cases.

When the entire meniscus is excised, a new one grows in from the parietal synovial membrane, having much the same form and general appearance as the normal structure. A regenerated meniscus is recognized by its dense attachment to the capsule and by the fact that it is thinner and narrower than the normal. It is composed almost entirely of fibrous tissue.

In those cases in which only the anterior portion of the meniscus is removed, the excised portion is replaced by fibrous tissue. The junction of the regenerated horn with the original posterior horn and the difference in color and width are clearly demonstrated in the author's illustrations. These observations point to the advantages of total over partial meniscectomy. "The most perfect replica possible follows total meniscectomy."

Five cases are reported in which a regenerated meniscus had been torn. Such lesions are rare because of the density of attachment of the regenerated tissue to the capsule and the consequent reduction in mobility. In 3 cases the anterior cruciate ligament was found to be divided and in the remaining 2 cases the anterior cruciate ligament, the collateral ligaments, and the capsule were extremely lax. It is significant that in all 5 cases lesions of structures concerned with maintaining the stability of the knee joint were demonstrated.

MAX CLIMAN, M.D.

Blastomycosis of the Skeletal System: Summary of 67 Recorded Cases and a Case Report. Paul C. Colonna and Thomas Gucker, 3d. *J. Bone & Joint Surg.* 26: 322-328, April 1944.

This article reviews the reported cases of blastomycosis of bone and adds another to the literature. Roentgenographically the bone changes suggest an ordinary osteomyelitis. No characteristic feature is presented. The condition is usually fatal, with a recorded mortality rate of about 89 per cent. Iodides and sulfadiazine did not seem to control the disease.

JOHN B. McANENY, M.D.

Pyogenic Coxitis: I. End-Results and Considerations of Diagnosis and Treatment. Paul H. Harmon and Carroll O. Adams. *Surg., Gynec. & Obst.* 78: 371-390, April 1944.

The aim of the authors is the determination of those factors which lead to best functional results following suppuration in the hip joint. A study was made of the end-results of suppuration in 147 hips in 132 patients of all ages.

Cases were divided into three age groups: (a) below four years, (b) four to twelve years, (c) above twelve years. The modification of the architecture of bone about the hip by infection, which in turn is the key to hip stability, is the most important factor in determining the final result. Variations are described in each age group, but in general those from four to twelve years showed the poorest results. The amount of bone remaining in the quiescent stage is influenced by the extent of the original embolic infection and the type of treatment employed, especially its efficiency in preventing dislocation, pressure within the joint, and further loss of bone by pressure and pathological fracture.

Early diagnosis is desirable. Aspiration of the hip joint with or without arthrotomy is the only method of establishing this in doubtful cases and is confirmatory in typical cases. Diagnosis by aspiration is often possible long before roentgenograms show a bony focus. On the other hand, by the second or third day of the acute illness there may be roentgen signs of dislocation due to the accumulation of suppurative products within the joint capsule.

Following aspiration and/or arthrotomy, traction is usually preferred to plaster. Traction tends to reduce dislocation when present, prevents surface erosion of the bony cortex or pathological fracture, and allows fibrous tissue to fill in any defects in the articular cartilage. The location of the initial lesion has prognostic significance. If it is in the neck of the femur, necrosis of all or part of the femoral head, with or without pathological fracture of the neck, is seen. Initial lesions in the femoral head were not observed. When the osteomyelitic focus is in the bones of the pelvis, the joint is more often spared.

Sulfonamides are useful. It is pointed out, however, that the essential osseous picture following suppuration is not changed but modified in the direction of lessened virulence. The surgeon can await the evidence of localization of the osteomyelitis in roentgenograms with less danger of joint and other complications when these drugs are employed.

The authors conclude that a relatively benign course of the disease is seen (a) in the very young and in persons beyond the age of fifteen, in whom bone involvement is often restricted in extent; (b) in other age groups where the bone lesion is small or non-existent; (c) in cases where early arthrotomy and prolonged and continuous traction are employed. The greatest disability appeared in cases following massive osteomyelitis. A movable hip stabilized in the primary acetabulum is more desirable than an ankylosed hip unless such motion is accompanied by pain. Loss of leg length is chiefly due to dislocation of the hip and bone loss.

Roentgenograms with accompanying case histories illustrate this report. STUART P. BARDEN, M.D.

Pyogenic Coxitis: II. Indications for Surgical Treatment in Residual and Chronic Stages and End-Results of Reconstruction in 53 Patients. Paul H. Harmon and Carroll O. Adams. *Surg., Gynec. & Obst.* 78: 497-508, May 1944.

In this paper the authors review the results of 83 reconstructive surgical operations for residual deformities or other chronic disorders of the hip, performed in 53 of the patients in their original series (see preceding abstract). Just when such procedures should be undertaken depends directly upon the patient's age at the

onset of the acute phase and the rapidity and effectiveness of control of the initial suppuration.

Measures to eliminate discharge from draining sinuses that promise not to clear otherwise can be undertaken in a few months after subsidence of the acute phase. The first step is the discovery of the cause of the continued drainage, and for this purpose roentgenography and injection of the sinus tracts with opaque materials are the most satisfactory procedures. The most common causes are sequestra, epithelialized sinuses, and chronic bone abscesses. For their correction the authors employed sequestrotomy for all or a portion of the femoral head, radical excision of the ilium, or hip joint disarticulation. These procedures carried out on a single damaged hip gave satisfactory results in 80 per cent (average) of the 20 cases in which they were applied.

Malposition of the fused hip should not receive surgical attention until after the approximate age of twelve or thirteen years, unless the malposition is grossly exaggerated, and in this event later correction will usually be required. In general, surgical stabilization of slightly movable hips and positional correction in those already naturally ankylosed by the acute disease yield better permanent results in terms of painless extremities serviceable in weight-bearing than arthroplastic attempts to secure a movable hip.

For the equalization of leg length, the bone shortening operations were found to give uniformly satisfactory results. Epiphyseal arrest procedures were not in general successful. This is attributed to the fact that they were performed chiefly on adolescent girls, at a time when it was not appreciated that longitudinal growth of the long bones in girls often ceases at eleven to thirteen years of age. While better results might be expected in a properly selected series, the authors consider the bone-shortening operation the procedure of choice.

The least satisfactory end-results were those in patients with bilateral deformities from acute involvement of both hips. Since these patients were seen before the modern era of arthroplasty, however, little in the way of treatment was attempted.

Like the earlier paper, this is illustrated by good roentgenograms.

Cause of Discrepancy in Length of the Limbs Following Tuberculosis of the Hip in Children. Arrest of Growth from Premature Central Closure of the Epiphyseal Cartilages about the Knee. Gerald G. Gill. *J. Bone & Joint Surg.* 26: 272-281, April 1944.

The retardation of bone growth in the lower extremity following tuberculosis of the hip is shown to be due to early closure of the epiphysis in the lower femur or upper tibia or both. This is best seen in roentgenograms of the knee, where a bony lock between the epiphysis and diaphysis occurs at or near the center of the cartilage plate. Multiple striations are seen to cross this region. In the lower femur the epiphyseal line forms an inverted V and the bicondylar notch is deeper than on the normal side. In the upper tibia the line of epiphyseal union is flattened or forms an upright V; the tibial spine is underdeveloped and the articular surface sometimes becomes saucer-shaped. These changes persist throughout life but may be modified by added arthritic changes. The fibula may continue to grow, becoming longer than the tibia and even bowing.

There is no evidence that the tuberculous process is the cause of premature epiphyseal closure. This is believed to be due to immobilization followed by decalcification of the bone, with softening of the cancellous portion, which may become almost fluid. With the application of pressure the membrane ruptures and union follows between the epiphysis and diaphysis.

The extremities should be measured at frequent intervals and changes should be sought in the roentgenograms of the bones, so that the opportune time may be chosen for institution of corrective measures.

Six case reports are presented, and several roentgenograms are reproduced to demonstrate details.

JOHN B. McANENY, M.D.

Periarthritis of the Shoulder Joint. Arthur Steindler. *J. Iowa M. Soc.* 34: 134-138, April 1944.

Periarthritis of the shoulder joint most frequently involves the structures of the floor of the bursa. Tears of the tendon are followed by degenerative changes, which in turn may be succeeded by the deposition of lime salts. These calcareous deposits may perforate into the bursa itself, forming visible accumulations. Most often they come from the supraspinatus tendon, but they may also arise from the infraspinatus, teres minor, or even the subscapularis tendon. Tears may be either complete or incomplete. A "frozen shoulder" may result from an extensive tendinitis of the entire cuff with subsequent adhesions, or a primary villous bursitis may develop.

Radiographically there may be osteo-arthritis changes in the greater tuberosity, with the formation of subchondral cysts and eburnation at the points of insertion of the tendons.

Clinically the process may be classified as a complete rupture of the tendon, incomplete rupture of the supraspinatus muscle, or bursitis.

Conservative treatment, comprising fixation in a splint or cast, physiotherapy, or roentgen therapy, is used in (a) acute cases, (b) spasmodic cases, (c) cases with solitary adhesions, and (d) the infrequent case of spontaneously disappearing deposits. There are three additional measures applicable with advantage in the early stages. These are novocaine infiltration, needle lacerations of the calcified tendon, and injection or irrigation of the bursa.

Cases requiring operative treatment are: (a) adhesive bursitis with broad adhesions, (b) chronic non-adhesive bursitis with thickening of the surface of the bursa, (c) tendinous tears that do not undergo spontaneous repair. In cases of supraspinatus tears with or without calcified deposits, the author reports good operative results in 80 per cent. Excision of the bursa produced good results in only 50 per cent of those thus treated. In neither instance is the total number of cases given.

E. W. GODFREY, M.D.

Fractures of the Carpal Scaphoid Bone in Industry and in the Military Service. M. G. Henry. *Arch. Surg.* 48: 278-283, April 1944. Also in *Mil. Surgeon* 95: 199-205, September 1944.

Fracture of the carpal scaphoid is readily missed. It leads to pain and disability, offers a perplexing problem to the physician and is of industrial and military significance. In a five-year survey of an industry of a hazardous nature only 12 cases were diagnosed by the author, yet in four months at a large naval embark-

ation and receiving base he found 22 cases. All of the latter group were the result of falling on the hand during rigorous exercise maneuvers.

All wrist sprains not showing progress in a week should be examined radiographically, with the hand in extreme ulnar deviation at the wrist joint. Complete fracture through the middle to inner third with any degree of displacement should be treated by excision, as the damage to the circulation usually prevents union, and a better functional result is thus secured. For crack fractures immobilization, diathermy, whirlpool baths, and passive and active motion are indicated. Comminuted fractures of the outer third should be treated by excision of the fragments only, the main piece of bone being left. Dislocations and crushing injuries require complete removal of the scaphoid. In the five-year industrial survey, non-union was observed in 25 per cent of the cases; in the larger group of military cases the percentage was 32. Early excision led to excellent functional results.

[While the technic favored by the author for roentgen demonstration of the scaphoid is good, there are others which should not be neglected. The abstractor's experience is that crack fractures will not infrequently be demonstrated on only one of a number of technically good views of the scaphoid, and when there is a question several positions rather than any one would seem to be indicated.]

LEWIS G. JACOBS, M.D.

Fracture-Dislocation of the Base of the Fifth Metacarpal Bone. Bryan C. Murless. *Brit. J. Surg.* 31: 402-404, April 1944.

Dislocations of the 5th metacarpal without associated dislocations of the other bones of the hand are rare. A case is described in which there was little clinical evidence to suggest the nature of the injury. Radiographic examination showed the base of the 5th metacarpal displaced forward and toward the radial side. A small detached fragment of bone was noted lying to the medial side of the wrist. This was demonstrable only in the anteroposterior view taken in supination.

Seven similar cases are reported from the literature. The detached fragment was demonstrable only in those cases examined roentgenographically with the wrist in supination. The fragment is most likely detached from the base of the 5th metacarpal. If manipulation is undertaken immediately or within a reasonable time, the dislocation may be successfully reduced and maintained in position. In the author's case reduction of the dislocation was successfully carried out six hours after the injury.

MAX CLIMAN, M.D.

March Fractures of the Tibia and Femur. Samuel E. Proctor, Thomas A. Campbell, and Martin Dobelle. *Surg., Gynec. & Obst.* 78: 415-418, April 1944.

A series of 1 femoral and 7 tibial march fractures is reported, including an example of bilateral march fracture of the tibiae, the fourth to be reported.

These cases were seen at an army station hospital. In cases involving the tibia the presenting symptom was pain in the upper tibia, coming on during strenuous exercise and followed by lameness. The only abnormal laboratory findings of note were the consistently lowered serum calcium levels and slightly elevated serum phosphorus levels.

Calcium therapy and immobilization casts were not used. Treatment consisted in physiotherapy and cessation of all strenuous exercise.

proved to be a tuberculoma. The ureter showed inflammatory change but no tubercles.

J. FRANCIS MAHONEY, M.D.

Diverticulum of the Female Urethra. John G. Menville and Joseph D. Mitchell, Jr. *J. Urol.* 51: 411-423, April 1944.

Menville and Mitchell review the 69 previously reported cases of diverticulum of the female urethra and report 11 cases of their own. Many causes are suggested for these, the most common in the opinion of the authors being trauma. Infection is the most frequent complication, occurring in almost every case. It is this that causes the majority of symptoms. The typical history is exemplified by intermittent attacks of dysuria, frequency, partial incontinence, discharge of pus or a cloudy urine from the urethra, and urethral pain. The pathognomonic sign is a fluctuating mass which empties on pressure.

Injection of the diverticulum through a catheter in the neck of the sac or urethrography will enable one to visualize the diverticulum roentgenographically.

The authors feel that the treatment of choice is excision of the sac.

The roentgenograms used to illustrate the paper show the lesions clearly. JOHN O. LAFFERTY, M.D.

Importance of the Roentgen Examination in the Diagnosis of Adenoma of the Prostate. Athayde Pereira. *Am. J. Roentgenol.* 51: 600-613, May 1944.

The substrate of adenoma of the prostatic urethra is an intense cellular hyperplasia of the submucous or suburethral glands, sometimes called Lendorf's accessory periurethral glands. These are of endodermal origin. The clinical forms of adenoma of the prostate are characterized by the solitary or combined growth of these cell groups. On the other hand, the prostatic glands properly so-called (of mesodermal origin) when affected by tumoral new growth (adenoma) may cause enlargement of the organ with the same clinical manifestations as total adenoma of the submucous glands. The direction of the growth from either source may be vesical, subvesical, or perineal. At present the development of adenoma of the prostatic glands, properly speaking, is thought to have the same origin as that of tumors in general, while adenoma of the suburethral or submucous glands is thought to be due to a hormonal disequilibrium due to change of life.

The technic of urethrocytography consists in first filling the bladder with the contrast medium for the purpose of showing its entire outline and then filling the whole of the urethra (15 to 20 c.c. of contrast medium). A roentgenogram is made exactly during the terminal part of the urethral injection. Films are made in lateral oblique and anteroposterior positions. The contrast medium used is a suspension of "luxobarium" (which has a barium sulfate base) in the proportion of 60 gm. of powder to 100 c.c. of boiling water. The points to be considered in the roentgen diagnosis are: (a) the characteristics of the bulbar filling; (b) the form and relations of the membranous urethra to the adenoma; (c) the elongation, deformities, dilatations, and angulations of the prostatic urethra; (d) the arrangement of the "internal sphincter" in relation to the bladder cavity; (e) the configuration of the elevations on the basal plane of the bladder; (f) the perfection, the clearness, and the deformities of the outline of the bladder.

In solitary middle lobe enlargement, the "internal sphincter" is directed forward, there is angulation of the prostatic urethra, and the nodule protrudes into the bladder back of the "sphincter." If there are accompanying lateral lobes with a subvesical or intravesical growth, there is a varying degree of elongation of the prostatic urethra. In the ventral lobe (rarely seen) the "sphincter" is turned upward, the tumor nodule protruding into the base in front of the "sphincter." In total adenoma the lateral lobes in the profile roentgenogram project more or less into the base with equal or unequal growth of the two sides, the "sphincter" is turned upward, the image of the urethra is not elongated in the beginning but becomes increasingly elongated, broadened, and deformed as the adenoma nodules increase in size.

This method of examination is contraindicated (a) following recent trauma from instrumental examination; (b) in patients with acute or recent gonorrhea; (c) in the course of subacute adnexitis; (d) in the course of treatment of abscess of the prostate. Among other advantages of this examination, it shows the relation between an adenoma with subvesical growth and the parts of the membranous and bulbar urethra, giving a warning of the dangers of instrumentation, and it permits of differential diagnosis between adenoma of the prostate and dysectasias of the neck.

CLARENCE E. WEAVER, M.D.

TECHNIC AND APPARATUS

Design for an X-Ray Department at an Advance Base Hospital. John W. Olds. *U. S. Nav. M. Bull.* 42: 935-947, April 1944.

The author describes in detail the adaptation of a 20- by 48-foot steel hut for use as a radiographic department at an advance base hospital. A central corridor extends the length of the building. The front section is utilized as an office and film-reading room on one side and as a waiting room on the other. Films on inactive cases are filed in discarded 14 X 17-in. film boxes in built-in compartments beneath the benches in the waiting room. The carrying case for the portable x-ray unit is similarly stored.

The central portion of the hut is given over to two general x-ray rooms. The partitioning for the corridor extends only along one side, and a combined fluoroscopic and radiographic unit is set up in the spaces provided. Double doors 8 feet wide and 6 1/2 feet high open into the corridor, and when these are swung back, the effect is that of a single large room. A mobile unit is operated in the adjacent area.

The space at the rear of the hut serves as a film-processing and storage room.

The author advises that grids be kept in the original hardwood shipping case and a plywood panel be inserted to maintain constant pressure to prevent warping in regions with high humidity. Radiographic equipment should preferably be connected to a generator ahead of any other connections which draw a significant amount of current, in order to produce stability of voltage.

E. W. GODFREY, M.D.

The Magazine Cassette X-Ray Unit. H. R. Edwards and Aaron Siegel. *Am. Rev. Tuberc.* 49: 366-373, April 1944.

A description is given of a magazine cassette unit for

rapid chest radiography in mass surveys. The unit uses sensitized paper in rolls, each of which provides fifty 14 × 17-in. films. Mechanically, the unit can be operated at the rate of 100 cases per hour; in general, the speed depends upon the staff available. The authors favor paper film over microfluorograms and over the corresponding 14 × 17-in. cellulose base films because of the saving in cost. The unit is provided by the manufacturer of paper film on a rental basis. It can be used with standard x-ray equipment and darkroom facilities and can be employed effectively with equipment of low capacity.

L. W. PAUL, M.D.

Instantaneous Stereography. G. L. Rogers. Brit. J. Radiol. 17: 122-125, April 1944.

Instantaneous stereography is a method of making stereograms by means of two tubes on one plate through a grid. There is a definite relationship between the distance from the grid to the film, the distance from the focal spot to the plate, the distance between the targets, and the number of lines in the grid. The method is of particular use for studies of the heart and viscera, for arteriograms and venograms, and for localization of radium needle implants.

SYDNEY J. HAWLEY, M.D.

RADIOTHERAPY

NEOPLASMS

Meningioma of Thirty Years' Duration: Report of a Case. R. B. Cloward and R. D. Kepner. Arch. Neurol. & Psychiat. 50: 327-334, September 1943.

The case of a patient with a recurrent intracranial meningioma of the right frontal lobe of thirty years' duration is presented. This, the authors believe, is the "oldest" meningioma yet recorded.

The slow rate of growth of this lesion is explained by several factors. The original tumor was probably a meningioma *en plaque* arising from the sphenoid bone. Cushing's statistics show that such tumors grow very slowly and have longer clinical histories than any other intracranial meningiomas. Furthermore, the lesion was located far forward in the frontal lobe and remained symptomless for a long time. The skull flap had been completely removed at the time of the first operation, and for this reason the tumor had plenty of room to expand without producing a significant increase in intracranial pressure.

Roentgen therapy was administered following the initial operation, and the authors suggest that the roentgen rays, producing sclerosis and fibrosis of the dura, blood vessels, and bone, may have increased the resistance of these tissues to the invading neoplasm and thus further retarded tumor growth.

DEPARTMENT OF ROENTGENOLOGY
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Modern Trends in the Treatment of Carcinoma of the Breast. Oliver Chance. Irish. J. M. Sc., April 1944, pp. 105-110.

A statistical study was made of 104 patients referred to St. Anne's Hospital, Dublin, for radiation therapy of cancer of the breast recurring after operation alone. Radical mastectomy had been performed in 67, and simple mastectomy or local excision of the mass in 37 instances. In the radical operative group, local metastases occurred in 39 per cent, metastases in the axillary or supraclavicular nodes in 47.5 per cent, distant metastases in 13 per cent. For the simple operative group, the figures were: local metastases, 65 per cent; lymph node metastases 29.5 per cent; distant metastases 6 per cent. Following irradiation, the group with local metastases had a three-year survival rate of 35 per cent and a five-year survival rate of only 8 per cent; the cases with lymph node and distant metastases had a three-year survival rate of 38 per cent and a five-year survival rate of 33 per cent.

The author concludes that radical mastectomy gives

a better chance of survival than local amputation or excision of the tumor. Noting that recurrences were apparently sterilized in one out of three cases, he suggests that Keynes' method of simple mastectomy followed by radium application to the chest wall and lymph node areas should be further investigated.

The author's general treatment plan calls for radical mastectomy when possible. No postoperative irradiation is given when the mass is local and freely movable unless microscopic section shows node involvement, in which case only the axillary and supraclavicular areas should be heavily irradiated. Preoperative irradiation is given in operable cases only when aspiration biopsy shows considerable anaplasia of the tumor. Irradiation may render an inoperable carcinoma operable, and in such cases postoperative irradiation may also be given. When the primary lesion is operable but the nodes are not, amputation of the breast and irradiation of the node-bearing areas are indicated. Irradiation of the chest wall is reserved for cases showing metastatic disease; in such cases radium is preferred to x-rays. Bone metastases show the most spectacular response to irradiation.

LESTER M. J. FREEDMAN, M.D.

Treatment of Carcinoma of the Lung: Symposium. J. L. Livingstone, R. C. Brock, Ffrangcon Roberts, J. L. Dobbie, and W. L. Harnett. Brit. J. Radiol. 17: 101-109, April 1944.

Livingstone, opening this symposium on bronchial carcinoma, states that the disease is invariably fatal, though a patient may survive a long time without treatment. One woman is known to have lived four and a half years, during which time she gained 18 pounds.

At the present time the only curative treatment is surgical removal. This is possible in 10 to 20 per cent of cases, but earlier diagnosis will raise the percentage. Bronchoscopy and biopsy are essential when possible. Small peripheral tumors are the most difficult to diagnose. They are hard to differentiate from tuberculosis, lung abscess, metastatic growths, and hydatid and simple cysts.

Brock, while granting x-ray therapy a place in the treatment of bronchial carcinoma, considers that the only method which affords hope of a cure is surgery. Lobectomy is the operation of choice. With diagnosis in its present state of accuracy, some 10 per cent of the cases are operable—about half those now coming to operation. The mortality from lobectomy is 28 per cent, but with a selection of reasonably favorable cases this can be reduced to 15 per cent. In Brock's own

series of 32 cases surgically treated, there were 9 operative deaths; 8 patients died of recurrence within two and a half years. Of the 15 patients surviving, all had a good functional result. [In 5 of these, however, the interval after operation was less than a year, and in no instance did it reach five years.] The pleural space became infected in 2 cases.

Roberts believes that irradiation has much to offer the sufferer from bronchial cancer. Even in advanced cases there may be substantial relief of symptoms, and in many instances there is a material prolongation of life. In administering treatment, many small fields should be used. Twenty-four are advocated by this writer. Each field receives 1,200 r, giving a total skin dose of 28,800 r. The depth dose cannot be accurately determined. One patient was living and well after six years.

Bobbie reports a series of 170 cases of bronchial carcinoma treated by roentgen rays during 1935 to 1942; 57 per cent had secondary spread when first seen and 27 per cent had remote metastases. Tomography is regarded as a great aid in the diagnosis. Positive biopsies were obtained by bronchoscopy in only 34 of this series. Palliative treatment was given to 111 patients; 26 per cent lived more than six months, and 40 per cent had some relief of symptoms. Fifty-nine patients were treated radically by irradiation. Of these, 11 are alive, 8 for a year or more.

Harnett states that of 15,200 cases of cancer registered in the seventeen months prior to September 1939, 1,023 were primary bronchial carcinoma. The ratio of males to females was 4.6 to 1. The mean age of the males was 55.9 and of the females 57.7 years. Bronchial carcinoma accounted for 11.5 per cent of all cancer cases in males and 2.3 per cent in females. Fifty-nine per cent of the cases were so far advanced that treatment was purely palliative. Thoracic exploration was undertaken in 5 per cent, but only 1.5 per cent were suitable for pneumonectomy. Twenty per cent received deep x-ray therapy; 1.4 per cent were treated by intrabronchial radon, and 2.3 per cent by interstitial radon. The average time between the first symptom noticed by the patient and death was 10.2 ± 0.3 months.

SYDNEY J. HAWLEY, M.D.

Carcinoma of the Cervix, End Results. Charles A. Behney and John Y. Howson. *Am. J. Obst. & Gynec.* 47: 506-512, April 1944.

In 1931, Behney (*Am J. Roentgenol.* 27: 877, 1932) made a study of the duration of life of 437 women with cervical cancer who had been seen in the Radiologic Department of the Philadelphia General Hospital and followed until death, in an attempt to determine the value of high-voltage therapy. In the ensuing years (1931-1942), 579 additional patients have died of this disease. The present study is based on observations in this latter group, which are compared with the findings in the earlier series.

From 1928 to 1931 all patients whose general condition permitted were treated with high-voltage therapy regardless of the extent of the disease. The usual dosage was 1,600 to 1,800 r (in air) to each of four to six fields, 15×20 cm., depending upon the size of the patient. In the late stages, this was the only form of treatment. Lesions in the first, second, and third stages received, in addition, radon in the cervical and uterine canal and radon against the vaginal portion of

the growth. The intracervico-uterine dosage ranged from 2,000 to 3,000 mc. hr., depending on the depth of the cervical canal. The vaginal application of radon was made in three sittings; 1,000 mc. hr. with a filtration of 0.5 mm. silver and 3.0 mm. lead and rubber (approximately equivalent to 2.0 mm. platinum) at a distance of 1 cm., applied transversely against the cervical growth and into each vaginal fornix to provide a three-directional cross-fire, totaling 3,000 mc. hr.

After 1931, many Stage IV patients responding favorably to high-voltage roentgen therapy were subsequently treated with the standard dosage of radon in the uterine and cervical canals and against the vaginal portion of the cervix, followed six to eight weeks later by a second course of high-voltage therapy. Since 1938 an ever increasing number of patients have also received transvaginal high-voltage roentgen irradiation. In other respects the technic of treatment in the two series was identical.

The later series included 5 Stage I and 27 Stage II cases (as compared with 1 and 3, respectively, in the earlier series), 168 Stage III, 260 Stage IV, and 119 Stage V cases.

Of the patients with Stage I lesions, 1 died before treatment could be instituted, from another cause. The average duration of life for the 4 treated patients was 9.5 months as compared with 21 months for the single patient in the earlier series.

For 20 patients in Stage II receiving high-voltage x-ray therapy and radon, the average life span after admission was 17.2 months, as compared to 13.3 months for the 3 Stage II cases in the first group. In the remaining 7 cases treatment was refused or incomplete.

Of the Stage III patients, 11 were untreated and survived for an average of 4.6 months. Twelve treated by radium alone lived for an average of 9 months. Ninety-nine received the standard treatment—high-voltage roentgen therapy and radon—and lived an average of 18.8 months, an improvement of 7 months (40 per cent) over the group reported in 1931. Forty-six patients treated only with high-voltage roentgen rays, applied externally and in some cases transvaginally, lived an average of 10.8 months, an improvement of almost 4 months (50 per cent) over the comparable group in the earlier series.

Of the 260 Stage IV patients, 85 were untreated, and their average duration of life was only 1.8 months. Four patients had intravaginal applications of radon with 0.5 mm. silver and 5.0 mm. lead filtration at a distance of 1 cm. and lived an average of 8.66 months. In 10 patients receiving high-voltage therapy the tumor regressed so that the cervix was again movable, and these were subsequently treated with radon. They lived an average of 13 months. One hundred and sixty-one patients treated with external high-voltage radiation alone lived an average of 7.9 months. The duration of life in the group treated with heavily filtered radon was twice as great as for those treated by lightly filtered radon in the earlier period. Also, those receiving x-ray therapy and radon lived twice as long as those previously reported.

For Stage V cases, the average survival periods were as follows: 60 untreated, 2.4 months; 52 receiving high-voltage therapy alone, 12.4 months; 7 treated by high-voltage x-rays and subsequent radon application, 14.1 months. The only considerable difference from the earlier series was observed in those receiving only high-voltage therapy; these lived nearly twice as long

as those previously treated, probably because of more adequate dosage.

The authors believe that this study, especially when considered in conjunction with Behncy's earlier report, indicates the value of high-voltage therapy in carcinoma of the cervix. The best results were obtained in those patients who, after regression of the primary lesion had been brought about by high-voltage x-ray therapy, were subsequently treated by heavily filtered radon at a distance of 1 cm.

STEPHEN N. TAGER, M.D.

Late Bladder Injuries Following Treatment of Carcinoma of the Cervix. David M. Farrell and George A. Hahn. *Urol. & Cutan. Rev.* 48: 165-168, April 1944.

Three types of bladder reactions following irradiation for carcinoma of the cervix are recognized: (1) a primary erythema, appearing within twenty-four hours; (2) a secondary erythema, some four weeks later; (3) a tertiary reaction, which may occur any time after a year. The primary erythema is a non-specific reaction to a local irritant. It may be symptomless or may be manifested by a mild urinary frequency. The secondary reaction is a specific one and varies from congestion to acute inflammation with fibrinous exudate. It yields promptly to local treatment. Symptoms of the tertiary reaction are hematuria, dysuria, and frequency, usually of sudden onset. The bladder shows telangiectatic areas with sloughing, ulceration, and co-existent infection. The lesions are the result of an obliterative endarteritis.

Bladder injury following radiotherapy for cervical cancer is not usually due to overdosage of radium or x-rays. A possible contributory factor is the sensitivity of the skin. Its thickness, pigmentation, and blood supply may all play a part. The size and shape of the applicators and the amount of filtration are other factors to be considered. In interstitial irradiation it is essential that most of the beta rays be removed.

The diagnosis of bladder changes can be made with certainty only by cystoscopic examination and biopsy. A common error is to mistake a radiation reaction for a metastatic cancer. This is of serious significance, since it may lead to further irradiation, producing irreparable injury in an already severely damaged organ. Treatment is directed to relief of symptoms, prevention of infection, and improvement of the patient's general condition. The prognosis is good if the patient recovers from the acute episode of bleeding.

Two cases of tertiary bladder complications of irradiation therapy of cervical cancer are presented, in one instance ten years following treatment and in the other a year and a half. In neither case was there any evidence of recurrence or extension of the original tumor.

MAURICE D. SACHS, M.D.

Malignant Cystadenoma of the Ovary with a Pleural Effusion (Meigs' Syndrome). Horace B. Anderson. *Pennsylvania M. J.* 47: 671-675, April 1944.

Unless the possibility of Meigs' syndrome—ovarian tumor, ascites, and pleural effusion—is kept in mind in the differential diagnosis of pleural effusion in women, many such cases will be diagnosed as metastatic or primary carcinoma of the lung or pleura. The ovarian tumor leading to this syndrome is usually a fibroid on the right side, and the effusion, which is also usually on the right, clears up spontaneously when the tumor is removed. Cure has never been effected by deep therapy,

and there are no reports of spontaneous disappearance of the effusion.

The author reports a case with the usual symptoms. Deep therapy to the right chest brought no change in the amount of fluid. Irradiation of the pelvis caused a decrease of fluid in the chest but recurrence was prompt. At operation a large ovarian tumor on the right side was removed. The pleural effusion disappeared and the patient made an uneventful recovery. The tumor proved to be a malignant cystadenoma.

JOSEPH T. DANZER, M.D.

TECHNIC AND APPARATUS

Calibration of X-Ray Equipment for Superficial Therapy. C. E. Eddy. *Arch. Dermat. & Syph.* 49: 250-252, April 1944.

This paper was inspired by an article by Belisario and Pugh appearing in the March 1942 issue of the *Archives of Dermatology and Syphilology* (Abst. in *Radiology* 39: 381, 1942). In that article the authors listed the facilities for calibration existing in Australia, England, and America. Eddy does not believe that the statements concerning the facilities available in Australia present a fair picture. "This may be due partly to the fact that a considerable delay ensued between the collection of the data and the publication of the paper and partly to the fact that, in general, facilities for calibration of x-ray equipment are utilized somewhat earlier by radiotherapeutists than by dermatologists."

The Third Australian Cancer Conference in 1932 recommended that the Department of Health should prepare an Australian standard of roentgen dosage so that dosimeters could be checked against a free air standard dosimeter and, during the year 1933, an apparatus of the type developed at the Bureau of Standards in Washington, D. C., was set up at the Commonwealth Radium Laboratory. Later a similar instrument was set up at the University of Sydney.

Since 1935 competent physicists have at intervals calibrated the equipment at government and private hospitals. Features of the service are as follows:

1. The free air output, expressed in terms of the half-value layer, is measured for every combination of tube voltage, tube current, filtration, and focal skin distance used in treatment.

2. Treatment cones are investigated.

3. Tables showing relation between the skin dose and free air dose for various areas, qualities of radiation, and thicknesses of tissue are supplied.

4. Tables are given for different conditions of treatment, based on the work of Packard and Mayneord.

5. A technical chart is furnished, showing the time required to give certain dosages.

It is not necessary that each hospital or radiotherapeutist possess a clinical dosimeter. In fact, it is better to have a constancy meter that can at times be checked by a physicist.

JOSEPH T. DANZER, M.D.

RADIATION EFFECTS

Irradiation Sickness: Hypothesis Concerning the Basic Mechanism and a Study of the Therapeutic Effect of Amphetamine and Dextro-desoxyephedrine. E. L. Jenkinson and W. H. Brown. *Am. J. Roentgenol.* 51: 496-503, April 1944.

The use of amphetamine and dextro-desoxycphed-

rine in the treatment of irradiation sickness is reported. Of 69 patients showing irradiation sickness during courses of therapy, 27 received amphetamine and 42 desoxyephedrine. No attempt was made to evaluate the relative effectiveness of the two drugs. Of the total cases, 80 per cent showed good responses, 14 per cent fair, and in 6 per cent the results were negligible with either of the two drugs. The effectiveness of the drugs appeared to be reduced by anemia, nutritional and metabolic changes associated with debilitation, and by extensive metastasis.

The dose and method of administration of the drugs are of utmost importance and must be varied according to requirements of the individual patient. The first dose is given thirty minutes before breakfast, during which time the patient remains in bed. The second dose is given at noon, and the third at 4 P.M. Five to 10 mg. of amphetamine or 2.5 to 5 mg. of *d*-desoxyephedrine are given per dose, depending upon the size of the patient and the severity of the symptoms. Usually, smaller doses are given at first, being increased until the therapeutic effect is obtained. The total daily dose does not exceed 30 mg. of amphetamine or 20 mg. of *d*-desoxyephedrine. Both are administered orally.

The authors discuss various theories and explanations of the etiology of irradiation sickness. Increased capillary permeability due to injury from the roentgen rays appears to be the basic factor. The pharmacology of the drugs employed indicates that they are of therapeutic value in irradiation sickness through their action in maintaining the peripheral circulating blood volume and preventing visceral stasis and splanchnic dilatation. It is important that corrective measures be instituted in the presence of anemia, dehydration, acidosis, and the deficiencies associated with debilitation and nutritional disturbances, since these conditions, as pointed

out above, appear to reduce the effectiveness of either drug.

L. W. PAUL, M.D.

Variations in Sensitiveness of Different Skin Areas to the Erythema Dose of Roentgen Radiation. Julian B. Herrmann and George T. Pack. *Am. J. Roentgenol.* 51: 504-507, April 1944.

The sensitiveness of 13 different skin areas to low-voltage roentgen rays was tested in a group of 21 patients. Variation in sensitiveness of different skin areas in the same person and of homologous areas in different persons was encountered. The axilla and groin appeared to be the most sensitive, and the hand and foot the least sensitive. The forearm was more sensitive than the thigh, while areas over the sternum and the sixth dorsal vertebra held a position intermediate between these two. The dorsum of the hand and foot were found to be more sensitive than the palm or sole. No appreciable difference in sensitiveness was found on the basis of sex or complexion. Skin of elderly, debilitated patients appeared to be less sensitive than that of younger, more robust persons.

The radiation employed in the test consisted in doses of 400 r measured in air, using 100 kv., 6 ma., 1 mm. Al, 15 cm. target-skin distance, 2-cm. diameter cone. On any one patient, six areas were exposed to this amount of radiation, which was chosen as just above the threshold erythema dose. The areas were examined daily or every other day for two to four weeks thereafter, and the observed reactions were graded from one to four.

The reason for differences in sensitivity of various skin areas is not clear. It is probable that circulation and the thickness of the skin play a role, but this does not seem to be the entire explanation.

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